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Electrical Patents. OUR patent record will be found unusually interesting this week. It includes nearly 70 patents, and a large number of these pertain to the Westinghouse alternating system of electric lighting. The exhibit shows how much is required for the building up and perfection of a great system of electric lighting, and how steadily the march of improvement goes on.

Mayor Hewitt on Arc Lighting. IT appears that Mayor Hewitt, with wonted thoroughness, has been investigating for himself the question of safety with arc lighting. He finds that although no fewer than 7,000 arc lights are now in use in this city, the number of deaths recorded since their introduction nearly ten years ago is only four, and that in two of the cases the unfortunates were linemen. Hence there are left two "accidents," one of which is explainedby the fact that the deceased deliberately played with an arc lamp. We need not wonder, therefore, that Mayor Hewitt should say, "So small a proportion of accidents is almost unworthy of notice." It is open to question whether any other like boon of modern civilization can produce such an insignificant record of fatalities attending its use. The Mayor is also right, it would seem, in surmising that some people have magnified the danger for reasons of their own.

Another Fundamental Storage Battery Patent. THE present status of litigation on the ownership of the rights to the storage battery in this country receives, it would seem, a most important development in the issuance, last week, of a patent to Camille A. Faure, for a method of applying the active material in the form of a paste to the plate of a storage battery before its immersion in the battery fluid. Our readers will remember that in 1885, a patent for the general application of an active material was issued to Mr. Chas. F. Brush, after a tedious litigation in the patent office.

Compensating Resistances. THE variation of resistance due to temperature, occurring in wires, requires that very accurate account be taken of their temperature, especially in cases where heavy currents are employed which are particularly apt to heat the wires. In measuring very heavy currents where the instruments are not capable of taking in the entire current, the shunt method, though extremely convenient, labors under the difficulty that the resistance, at whose terminals the E. M. F. is taken, is apt to vary owing to its heating. A standard with a practically constant resistance, therefore, with considerable range of temperature, is a great convenience, and that described by Prof. Nichols before the American Institute of Electrical Engineers is a most ingenious adaptation of well-known principles, and is so easily constructed that its use will no doubt become widespread.

Edison and the Quadruplex. IN the very able review which Mr. F. W. Jones gives of Mr. Maver's articles on "Improvements in the Quadruplex," he differs with the author in a number of points, not only as regards the history but the practical value of many of the devices described. Mr. Jones, in the first place, casts doubt upon the claims of Nicholson to the authorship, or even joint authorship with Edison, of the quadruplex; and he cites dates and facts to establish his assertions. Indeed, the article is a strong defence of Mr. Edison, and of his claim to the practical accomplishment of the quadruplex. Mr. Jones points out that although a number of others have had ideas on the methods of working the quadruplex, and like Nicholson, are entitled to some credit, still the fact remains that Edison was the first to put a practical quadruplex in operation. As an historical record and comparison of methods—supplementing the original article—Mr. Jones' paper will be read with a great deal of interest.

Improvements in Cable Telegraphy. CABLE telegraphy, which has remained practically in its original condition almost since the start, has not been entirely neglected by inventors. The object has been to increase as much as possible the speed of transmission and to remove the causes which at times tend to interrupt transmission altogether. We noted some time ago the replacing of the mouse mill and the static electrification of the ink by an electro-magnetic device for vibrating the siphon. In this issue we describe an entirely new method of transmission which will, we are sure, interest the Morse operator in particular, as by it he is enabled to send and receive without any change in his usual style of work. Mr. Delany recognizes the difficulty that arises from sending signals into the cable, involving the opposite charging of the cable in the formation of single letters, and has devised an arrangement in which all the signals, both dots and dashes, are transmitted from the same side of the battery, thus varying as little as possible, the charge of the cable at each signal, and in this way decreasing the time for the neutralization of reversed charges. The results which he has obtained thus far are most promising. A test on a longer cable than that experimented with may lead to a wider application of this method.

Alternating Current Motors. WE are once again brought face to face with a remarkable coincidence as to the direction in which two minds, widely separated from each other, may work. It is but a few weeks since Mr. Tesla read before the American Institute of Electrical Engineers a paper descriptive of a new method of obtaining inductive action, which can be applied to the operation of secondary generators, and more particularly to the working of alternating current motors. This method, it will be remembered, is based upon the principle of a continuous progressive movement of the magnet poles in a closed magnetic circuit. In this issue we publish a method which is the result of the studies of Professor Ferraris, and in which he follows almost the very same line of argument as that adopted by Mr. Tesla, while his illustrations and work are so close to those employed by Mr. Tesla, that the coincidence is specially remarkable. That there could have been no connection between them goes without saying. It will be remarked, however, that while Professor Ferraris, so far as is discovered in that article, has allowed the subject to rest merely with an experimental demonstration, and with the pointing out of the direction in which to work, Mr. Tesla has advanced further into the subject and applied the results of his reasoning to the construction of apparatus which has already a commercial form. It is with the object of enabling our readers to compare the lines of thought followed by both of these workers that we cite in this issue the work of Professor Ferraris, which may, we hope, bring the subject more clearly to general comprehension. While this coincidence is in itself extraordinary, we have since been advised that still another inventor has been working in the same direction and had accomplished similar experimental results. With these coincidences before us, it becomes evident that they who would obtain the credit for original work must be quick at publishing it, lest they be forestalled by others. In this way, perhaps, many vexatious controversies might be avoided. The instances are numerous where the credit for electrical inventions and discoveries is still a moot question after years of discussion.

On Death by the Electric Current.

BY R. M. HUNTER, M. E.

I was gratified to see in THE ELECTRICAL WORLD of May 26 an article from the pen of Dr. Robt. Amory, taking objections to Prof. E. J. Houston's reasons on death from electric current, as appeared in the paper of May 19. Dr. Amory has in a measure anticipated my views, which I was in the act of forwarding to this journal.

From my study of physiological phenomena, with especial reference to the action of electricity, I feel convinced that Dr. Amory's views are correct in the main. There is no doubt but that when a high potential current is passed through the human body, it affects the muscular activity and renders it passive. The muscles are under the control of the nervous system and any thing which interferes with the nerves will undoubtedly interrupt the normal muscular contractions which are necessary not only for the movements, voluntary or involuntary, of the person, but also the muscular action of the heart and the diaphragm, the latter so necessary to the proper respiratory movements of the lungs. When a high potential current passes through the body it acts upon the nerves, which in turn cause an instantaneous and strong contraction of the muscles; and the nerves becoming paralyzed, the muscles may slowly release their contraction, but they have no power to further perform their original duty. Death is primarily caused by complete prostration through the nervous system acting on the brain, and such sudden prostration is continued by asphyxia, owing to the non-action of the muscles.

The muscles cannot act without activity of the nervous system, and when this is paralyzed and inert, the circulation of the blood ceases with the cessation of the muscular action of the heart, and *permanent* death ensues. I term death that condition in which a person is brought, causing the heart to cease beating, and permanent death the condition when resuscitation cannot take place. I think that Dr. Amory is wrong in supposing that a person whose life has been extinguished by an electric current can be restored as in the case of drowning, because the conditions are not wholly the same. In drowning there is no paralyzation of the nerves, but death is caused there wholly by asphyxia as a prime agent. Death from drowning ensues simply, because the supply of oxygen being shut off from the blood, the vitality due to the oxidation of the carbonaceous tissues in the capillary plexus of the human system gradually becomes less; and as this slow combustion is the cause of heat and electricity of the system, and which electricity through the nerves is the cause of muscular movement of the heart to cause the proper circulation of the blood, the heart not receiving this actuating or exciting current in sufficient volume ceases to beat and the person is dead. The only reason why we can restore a drowned person to life is because the oxygen still retained in the blood after life has apparently ceased to exist, is sufficient, when aided with a forced respiration, to again cause the pumping action of the heart to take place. When a person is drowned the oxidation of the tissues goes on for nearly half an hour, after which the oxygen contained in the blood is exhausted, and then nothing will restore life.

In the case of death from a high potential current the nerves are paralyzed, and they cannot perform their function of exciting the muscular contraction of the heart, and hence any forced action of the diaphragm by manipulation may cause air to enter the lungs and oxidize the blood in the lung capillaries, but the exciting current caused by such oxidation or slow combustion cannot excite the nervous action of the heart. The muscular contraction of the heart cannot therefore be produced with paralyzed nerves, and resuscitation is an impossibility.

In making this statement I have reference to cases where the high potential currents of arc lighting are the cause of death. In cases when the current was only sufficiently strong to momentarily paralyze the nerves, resuscitation might be accomplished.

NEW BOOKS.

AMERICAN ELECTRICAL DIRECTORY, 1887-8. Published by the Star Iron Tower Company, Fort Wayne, Ind. 750 pp. Price, $2.

This is the latest issue of the Directory published by the Star Iron Tower Company, of Fort Wayne. It is a very handsome, massive, interesting and valuable publication, running a length of no fewer than 750 pages, all of which are printed in bold legible type. The directory opens with a good abridgment of the proceedings of the National Electric Light Association at the Detroit, Philadelphia and Boston meetings. This report occupies as many as 312 pages, and, in itself, constitutes a body of literature worth the price charged for the whole book. The next portion of the directory consists of an alphabetical list of the officers of the electric light companies; a list of manufacturers of electric lighting apparatus; isolated arc plants; isolated incandescent plants; electric lighting companies; prices of gas; lighting schedules, and the detailed reports of about 600 local companies. Such work as this, especially the last portion of it, involves a vast amount of correspondence, compilation, careful proof-reading, etc., and we are glad to find it done in such admirable shape. The detailed reports are very interesting reading, and show great varieties of station equipment with the same system of lighting, while in some cases large stations, with hundreds of lights, seem to have no two dynamos, engines or boilers alike. Just how far this eclecticism in the matter of installation is desirable—giving a man three or four styles of dynamos and lamps, and two or three kinds of steam plants to look after—it is hard to say; but the old feudal system under which a local company put in one system, arc or incandescent, but not both, and one make of engine, and foreswore all others ever after, seems a little bit broken up. Comparing some reports with those which were made from the same companies two years ago, we find a tremendously rapid rate of growth in a great many instances, not only in the larger cities but in a number of the smaller towns. A noticeable feature, also, is the number of gas companies that find their place in the lists as operating electric light plants, and another new class is that of the power companies.

A Criticism on Maver's "Improvements in the Quadruplex."

BY F. W. JONES.

THE ELECTRICAL WORLD of May 19 and 26 and June 2 contains a series of articles from the pen of Mr. Wm. Maver, Jr., the well-known electrician. Notwithstanding the fairness of the writer of these articles and his ability and extensive sources of information. I may be pardoned if I do not coincide in every respect with his views, historically or electrically.

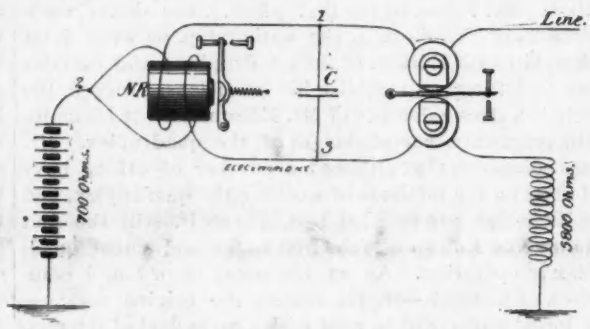
The foundation plan of the present successful quadruplex system was laid by Thomas A. Edison between New York and Boston in 1874, before Dr. H. C. Nicholson, an obscure physician of Kentucky, ever applied for a patent. Edison filed caveats and applications for patents in the United States, fully covering the essential features of all parts of the quadruplex system, and also secured patents in 1875 in several foreign countries. On the other hand, Nicholson, in 1875, for the first time, tried to work what he claimed was his quadruplex—the very best thing he then had in his brain—between Cincinnati and Chicago, and in the hands of the most expert chief operators and electricians of the Western Union Telegraph Company it proved absolutely incapable of working as a quadruplex.

The Western Union, knowing all this, and familiar with all of Nicholson's claims, afterwards paid an enormous sum for the Edison invention. After the lapse of eleven years Nicholson, assignor to the Western Union, secures a patent, as stated in Mr. Maver's article, "somewhat broadly covering the transmitting apparatus of the quadruplex." The application for this patent was filed in the U. S. Patent Office as late as Sept. 28, 1885, and issued in December of the same year. This patent, shrouded in doubt, delay and obscurity, never having passed the scrutiny of a court nor an unbiased examination by the press, is the stone upon which our historian stands to elevate the statue of Nicholson upon the pedestal of fame; and placing with eager hands the wreath of laurel upon its brow he grotesquely links the name of Nicholson with that of Edison as inventor of the successful quadruplex, no part of which Nicholson had the slightest part in inventing or perfecting. Much more appropriate, it seems to me, it would be to link with Edison's the names of Maron, Kramer, Schroeder, Stark and Bernstein, as they all clearly comprehended the idea over thirty years ago and constructed and published ingenious though impracticable systems.

Passing over the preliminary description of the system, on page 254 of THE ELECTRICAL WORLD we arrive at Fig. 1, the transmitter system; and Fig. 3, the "bug trap." An ordinary reader will naturally ask which of the firm of Nicholson and Edison contributed these devices. I think no one will deny that Edison's caveat No. 45, signed and witnessed October 28, 1873, contains the "bug trap" and substantially the key system.

At the foot of the third column of the above page we find that "the various instruments having been brought to a high state of perfection (*presumably by Nicholson and Edison*), the short core neutral relay, on account of its simplicity of adjustment having been adopted as the standard No. 2, and it being conceded that the existing quadruplex system was by all odds the best obtainable, the main thing left to be done, to increase the efficiency, was to improve upon the repeating sounder method of diminishing or bridging over the time of no magnetism in that relay." Here we are left under the impression that after the system leaves the hands of Edison and Nicholson the first attention is given to the "bug" by Mr. Gerritt Smith on account of the introduction of the dynamo electric machines in the Western Union (early in 1880) and that a device to remedy the difficulty was invented by Mr. Smith. Referring to Article II., page 266, Edison is singled out as the one who invented the "bug trap," the only invention so far in the description in which his partner, Nicholson, may not share unbiased renown. Following the above is a description of the various methods designed to obviate the mutilation of signals upon the No. 2 relay during reversals of current, and, without anything to intimate to the contrary, the ordinary reader is left to suppose that they are introduced in the natural order of their invention or application. We are informed that Fig. 4 shows *one effectual* means "of obviating the bug," and yet the inventor is not named! This device should be credited to Edison, as shown in his caveat No. 51, filed in the U. S. Patent Office, Dec. 9, 1874. So far from this device being an effectual means, it was tried in practice in 1877 for the first time and it was found necessary to use a condenser between the main and artificial circuits, precisely as shown in Fig. 7. This is amply confirmed by referring to a description and drawing of the Western Union standard quadruplex, published in 1877 in *Electricity and Electric Telegraph*, by Prescott, the electrician of that company. (See pages 850 and 855.) The Edison "bug trap" was always used in connection with the relay shown in Fig. 4 of Mr. Maver's article No. 2, to assist in preventing a mutilation of signals.

The same article states that this form of No. 2 relay was finally abandoned as "already intimated." In looking



IMPROVEMENTS IN QUADRUPLEX TELEGRAPHY.

back through this and the preceding article I fail to find any such intimation. What should have been stated is this, that the original system as tried between New York and Boston was put into use with a single-wound polarized relay (No. 1) and a single-wound neutral relay (No. 2), and these relays were included in the cross wire of a Wheatstone bridge with a rheostat and a condenser around the neutral relay to assist that relay in accepting and declining rapid changes of polarity, as fully described in the *Journal of the American Electrical Society*, 1875, Vol. I., No. 1, page 21. In 1875 the double deck relay (Fig. 5) to some extent replaced the ordinary neutral No. 2 relay as shown in diagram, page 839 of Prescott's work. The next improvement in the quadruplex was made between Chicago and Detroit, and Detroit and Buffalo in August, 1875, when the differential plan was put into successful operation for the first time (See *Jour Am. Elec. Soc.*, 1875; Vol. I., page 27). This plan was first tried by Edison in 1873 or '74, and abandoned for the bridge. The use of the differential plan was made feasible by the employment of a condenser as arranged in Fig. 7 between the main and artificial lines, and also of the more uniform winding of the two wires upon the bobbins of the relays.

About the beginning of 1877, the Edison compound polarized relays superseded both the neutral and double-deck neutral relay No. 2. This is also confirmed by a diagram on page 854 of Prescott's work. The same diagram also shows that the differential plan with condenser between the main and artificial circuits was borrowed from the Chicago, Detroit and Buffalo circuits, and adopted as the standard system of the Western Union. The compound relay was finally abandoned, as stated by Mr. Maver. This was in 1879. Through the recommendation of Mr. Charles H. Summers, electrician of the Western Union, the differential plan with the ordinary neutral relay was adopted. The patent on Mr. Smith's condenser arrangement was applied for January 3, 1885, issued June 2, 1885; the Moffatt & Blakeney plan (mentioned in Mr. Maver's article 2) was filed in Patent Office July, 1886, issued November 2, 1886. The plan shown in Fig. 6 was patented by the writer April 5, 1887, applied for in January of that year, The Postal Telegraph Cable Company has used the device with satisfactory results since the summer of 1885, and thereby rendered possible the reception of signals on the No. 2 relay during reversals on direct wires over 1,000 miles long, I think without doubt the longest quadruplexed wires in the world. Experimental tests upon these circuits demonstrated that all other devices were futile, and I may add that the important feature ascribed by Mr. Maver to Moffatt & Blakeney's "bug trap," viz., the employment of a continuous core in the induction coil, was used in the above case and long prior thereto.

Turning to Mr. Maver's description of the plan shown in his Fig. 7, he says: "The condenser depends for its difference of potential on the resistance of 'both coils of No. 2 relay.'" And again he says: "Generally speaking, this arrangement, while beneficial on some circuits, was not a decided improvement, the partial cause of which may have been that sufficient fall of potential between the plates of the condenser was not secured by the resistance of the coils of the neutral relay, and consequently the momentary currents produced thereby may have been too weak to effect marked results."

The diagram accompanying this article shows the arrangement described by Mr. Maver in his Fig. 7, and it will be readily seen that the condenser *C* does not depend entirely for its difference of potential on the resistance of both coils of No. 2 relay. The potential at point 1 depends upon the joint resistance of the battery and the artificial line, added to the resistance of one coil of the relay *N R* between points 1 and 2. Suppose the artificial circuit between point 2 and earth to be 6,000 ohms, and the internal resistance of the battery between point 2 and earth 700 ohms; their joint resistance would be 630 ohms, which, added to relay coil, say 200 ohms, in the line circuit, would make the resistance between point 1 and the earth 830 ohms; and the condenser stands 830 ohms above zero, and will be charged in conformity with the law governing the fall of potential from the distant station in a way well known, and the difference of potential of the condenser plates will be determined by the difference of potential between points 1 and 3, the latter point having nearly the same potential as point 2.

Mr. Maver further states: "The theory of operation of this device is that at the moment of reversal of the distant battery the condenser discharges its previously accumulated charge through the coils of the neutral relay in a way to at once reverse the magnetic polarity of its core, and thus shorten the moment of no magnetism." A reference to the patent will show an entirely different theory of operation, and I quote as follows:

"This result (reversals of current) constantly recurring will produce an unsteadiness in the signals, which will be detrimental, especially on long circuits of ordinary line.

"To obviate this difficulty I place the plates of a condenser *H* between the relays *A* and *B*, and connect one pole of the condenser to the wire *a*, thereby connecting it to the convolutions of the relays in the line circuit, and the other pole of the condenser is connected to the wire *b* and thereby to the convolutions in the artificial circuit. An incoming current fills the set of plates connected to the line circuit, and they attract by induction an equal and opposite charge on the contiguous plates, according to the well-known action of condensers. When the incoming current is withdrawn, the condenser plates discharge themselves through the relay *A*, passing through both convolutions of this relay (the neutral relay corresponding to *N R*, Fig. 7) to the point *C*, and the charge from each side of the condenser produces a momentary magnetic effect on the core of the relay, thereby filling in the neutral gap in the core between the withdrawal of a current of one polarity and the substitution of that of another, so that the signal will be steady and certain." (See patent 191,440, May 29, 1877). It will be seen that the condenser currents cannot reverse the polarity of the relay, but prolong its action until the reversed current arrives to reverse it. To pass unnoticed the statement that this device "was not a decided improvement" would be to allow an implied imputation against the judgment and integrity of Mr. C. H. Summers and Mr. F. L. Pope, upon whose report the patent was bought by the Western Union. From 1875 to 1882 there was not a quadruplex circuit over 200 miles long out of Chicago, Buffalo or Pittsburgh, that could by any means admit of good work, or even any work at all on the No. 2 relay except by the use of the condenser in the cross wires. This fact can be amply substantiated by the chief operators who had these wires in charge.

It may be noted that since the displacement, by dynamos, of the old Callaud No. 3 5″ × 8″ battery cells with an average internal resistance of 3½ ohms, the resistance between point 1 in the diagram and the earth has been materially diminished, so that, of course, the condenser cannot receive so great a charge as formerly. Even with the batteries used in the western division, viz., 6″ × 8″, the internal resistance, normally 2 ohms, was frequently double this. To Mr. Summers' credit, he would never consent to the use of the 5″ × 8″ batteries, which were very wasteful and greatly enhanced quadruplex difficulties.

In Fig. 8 of Mr. Maver's article we have the "bug trap" of Mr. Smith, previously alluded to as the first great improvement in such devices. The application for a patent was January, 1885, or ten years after Fig. 7 was put in use and five years after the dynamo machines replaced the Callaud batteries in New York Western Union Office. Here Mr. Maver stumbles again when he says: "The function of resistances *R R'* is to

furnish a difference of potential between the plates of the condenser *C* (Fig. 8). In Mr. Smith's specification no such function is attributed to those resistances. Mr. Smith declares that *R'* is to supplement in the artificial circuit the resistance *R* in the line for the purpose of preserving a balance of the relays to outgoing currents. Again Mr. Maver states: "This arrangement is devised *not* to hold the armature of No. 2 relay passive against its front stop at the moment of no magnetism, but like the Jones condenser is to cause a very rapid change of magnetic polarity of that relay. This is not quite in accord with Mr. Smith's specification, which says, "upon removing battery from line the discharging of the condenser sets up a current which continues to hold the armature of the relay towards the core."

It needs but a little calculation to show, and experiment to demonstrate, that as between Fig. 7 device and Fig. 8 devices in actual practice, other things being equal, there is a loss of 20 per cent. of the signaling current in the Smith plan by the introduction of the resistances *R* and *R'* if the device is used at both ends of the line. There is a loss of 33⅓ per cent. in the magnetic power of the relay *N R*, owing to the introduction of the third coil, which for three coils gives 133 convolutions to each, whereas in the relay shown in Fig. 7 there are 200 convolutions in each coil. Careful experiments made by me, with the valuable assistance of Mr. Minor M. Davis, show that on an actual working quadruplexed wire the comparative values of the devices shown in Fig. 6, Fig. 7 and Fig. 8 of Mr. Maver's article are as follows:

Fig. 6.	Magnetic strength of received signals	300
	Value of induction coil on reversals	300
Fig. 7.	Magnetic strength of received signals	300
	Value of condenser on reversals	50
Fig. 8.	Magnetic strength of received signals	175
	Value of condenser and 3d coil on reversals	75

New Automatic Fire Alarm System.

The system recently brought out by the Automatic Fire Service Company, of Milwaukee, Wis., embraces several novel features. Among these is a new thermostat or transmitter. Our illustration Fig. 1 represents the motor part of the transmitter, which consists of a hollow iron cylinder, screw threaded, and in which is fitted a brass piston. The cylinder contains an expansive substance, which operates at the temperature determined upon. Fig. 2 shows a vertical section of the transmitter with the motive device in position, and Fig. 3 shows the thermostat complete in perspective.

As the substance expands it forces upward a small brass piston, which rubs or cuts the ends of two metallic strips and closes an electrical circuit which instantly rings one or more bells at different places—generally, one in the office of the building and one at the nearest engine house. At the same instant it also shows on an indicator, Fig. 4, placed outside the building the part of the building where the fire is burning, and hence the firemen will lose no time in looking for the fire. The apparatus illustrated in Fig. 5 represents the bell board placed in the office of the building and upon which the alarms are also received. This board also carries a smash box containing a switch by means of which an alarm can be sent independent of the thermostats.

The system also embraces a suitable device for testing the integrity of the circuits, and the arrangement is such that by the removal of the testing key from its regular place the system is automatically removed from the department wires and the signals are only received on the office bell. The apparatus recommends itself as practical and efficient.

FIGS. 1, 2, 3, 4 AND 5.—A NEW FIRE ALARM SYSTEM.

Some Hope for Primary Batteries

BY B. J. W.

The interesting paper read by Mr. Francis B Crocker before the American Institute of Electrical Engineers and published in the last issue of this journal attracted my attention. The point to which attention is now called is this—after remarking upon the "chemical efficiency" of the battery, it is said that the possibilities of chemical generators are almost infinite; and further on it is remarked that their chief fault is in the apparatus, not in the chemical action. Having studied all the batteries patented in the United States since 1848 I arrived at the conclusion above stated, that primary batteries were so constructed that great loss of energy and waste of material was inevitable wherever strong and constant currents for long periods of time were required.

We set ourselves at work to construct a battery cell that should as far as possible be free from the faults which had impaired their efficiency up to the present time. We went through the usual trials, tests, disappointments and some of the successes attendant upon such enterprises. To make the story short, I will say that after two years of hard work in this one line of the mechanical construction of a galvanic cell, we have at last got one that answers our expectations more fully than we for a long time dared to hope.

The size of our outer jar is 7 × 7 × 8 inches deep. Its E. M. F. is two volts, current forty ampères on short circuit. I cannot describe the novel features of the battery here, as they are to be the subject for application for a patent. I will say, however, that I have a battery of twenty-four of the cells set up in this city, where we have called in parties who are engaged in some part of electrical work to witness its working.

To save Mr. Crocker the necessity of getting up 1,500 gravity cells to obtain one horse-power, I would be glad to show him my battery, which will furnish the needed 746 watts with 14 cells instead of 1,500.

While I was interested and instructed by reading Mr. Crocker's paper in all the scientific part of it, still I claim that there are some wrong figures in the commercial column and a little unfairness at the close toward the honest workers who are trying to improve primary batteries in the very points where he so clearly indicates improvement is to be looked for. Materials can be bought much cheaper than the figures given, and a much less amount will be required, as nearly all waste is prevented.

To double the quantity and make the price much too high—then multiply it by two in the case of the batteries for small plants, and then compare the cost with the cost of current generated by the dynamo in large plants, leaving out of the account the fact that in the case of the dynamo the furnishing of the current is only the beginning of expenses, as it must be *delivered* to all customers at very great cost and trouble—to make such a comparison is not fair or correct.

I have before me a test with a 5 h. p. plant, which would furnish only one 16 c. p. lamp to the h. p., and it would be quite as fair for me to cite this as a sample of what can be done with a dynamo as to cite a gravity battery for what can be obtained from galvanic batteries generally.

Induction Apparatus for Studying Dynamos.

In a patent recently issued to Mr. Jas. Swinburne, of Chelmsford, England, there is described an induction apparatus for studying dynamos and for developing new types. According to this invention, a model is made to scale, which consists of the ordinary field magnets and armature. There is no commutator needed, and the terminals of the wire are used instead of brushes. The armature is not rotated, but is held in position in the field, so that it can be moved round into any angular position representing a desired lead of the brushes. The induction through any part of the model is then measured by means of a pilot wire and a ballistic galvanometer. The galvanometer is calibrated by means of a pair of coils whose co-efficient of mutual induction is known. To find the "no load" curve of the machine, gradually increasing currents are passed round the fields, and the armature induction is noted by observing the motion of the galvanometer on the reversal of the exciting current. To take "full load" readings a current is also passed through the armature wire; when both the armature and field circuits are reversed, the induction is measured by means of a pilot wire, as the armature circuit alone is no longer convenient for the purpose. The distribution of the induction in the air space at different loads is measured by means of a pilot wire circuit. The change of induction through a section of armature conductor corresponding to one pair of commutator sections is taken by reversing the current in a model section without reversing the armature and field magnets. In the case of the alternating current machines the "no load" curve is not obtained directly from the total induction through the armature circuit; but as the E. M. F. at any instant depends on the rate of change of the total induction, the curve is readily found. To obtain full data a pilot wire is used, and the induction is determined at each armature position. As the models are apt to get very hot, the currents are manipulated by a switch, and the heating thus lasts only a short time.

Tempering Magnets.

A combined process for tempering and magnetizing steel bars for magnets is employed by M. Ducretet. He employs a water-tight vessel, at the bottom of which are two soft iron pole pieces; the poles of a powerful electro-

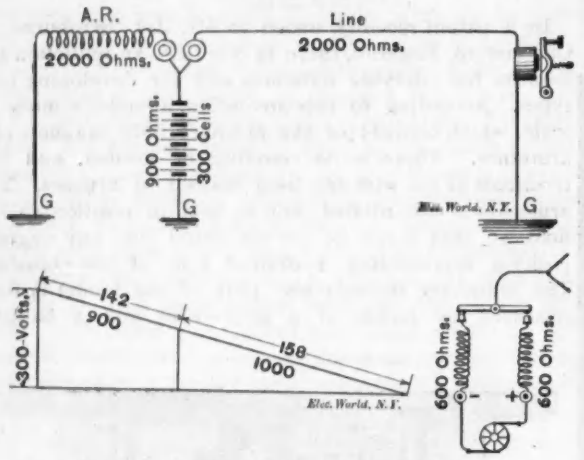
magnet are placed underneath these. The vessel is partly filled with water, and a layer of oil is above this. The red-hot bar is passed through these; its passage first through the oil is found to soften the steel without depriving it of its power of being magnetized.

Improvements in the Quadruplex.

BY C. L. HEALY.

In reading Mr. Maver's interesting article on the defects and remedies of the "bugs" in the quadruplex, I would like to point out that the most serious cause of half the trouble in existing quads is the varying potential that passes to the joint lines; and even the dynamo quad, as used by the Western Union Company, brings along with it the same trouble. This trouble is the varying potential that passes to the joint lines and is due to the internal resistance of the battery and, in the dynamo quad, the artificial resistance coils. These reduce the actual voltage on the line to a very much lower pressure than appears to be really known, and this vital point and its resultant effects on the practical working of the quadruplex during all kinds of weather has not been made clear.

Fig. 1 shows a quad line of 2,000 ohms. *A R* is an artificial line of 2,000 ohms to balance the line. We use on



FIGS. 1 AND 2.—IMPROVED QUADRUPLEX.

this line 300 cells of battery whose internal resistance is 3 ohms per cell, or 900 ohms; the joint resistance of line and artificial line is, therefore, 1,000 ohms, and the total resistance that the current flows through is 1,900 ohms. Calling our potential 300 volts we have a voltage per ohm, or ohms per volt, of $\frac{1,900}{300} = 6.33$ ohms per volt, and the fall of potential in this whole circuit is, consequently, 1 volt to every 6.33 ohms. The fall in the battery itself is $\frac{900}{6.33} = 142$, and in the joint lines 158, as shown in Fig. 2. This then is the effective pressure on our line and this voltage per ohm will vary just as the line varies its resistance and as we balance our artificial line.

Now take this same line and allow the resistance to fall considerably, as it will during heavy weather, and we further reduce our current at the distant end by lowering the potential to the joint lines; and as the joint resistance becomes lower the waste in the battery or artificial resistance increases in like proportion. Therefore, just when we want more current to allow for the leakage our potential is actually lowered. This is why the margin on the second side lowers and the old cry of "it don't come" is heard, and, as a rule, during heavy weather the second side is abandoned. The limit of working over heavy leakage is the safe carrying capacity of the fine wire of the relays. It would be possible to increase the potential to the line to allow for the leakage up to 80 per cent. if it were not for this.

The dynamo quad, as used by the Western Union Company, has this same defect of internal resistance, which consists of an artificial resistance. Fig. 3 shows this. Here a resistance of 600 ohms is used between the dynamo and the joint lines, which in this system is necessary to prevent the pole-changer points from fusing, and, while less than the battery, it is still considerable; and the same law holds good for the drop in potential in the total circuit, as shown in Fig. 2. This is also partially the cause of arcing at the pole-changer points, due to having to connect to a higher dynamo potential than that actually available on the line.

In order to increase the efficiency of the quadruplex for all states of weather, we must look to the cause of its present trouble, general poor insulation of our lines; and unless we keep the potential to the line nearly constant with that of our initial pressure, and provide means for increasing this for the loss due to leakage in heavy weather, we cannot hope to have sufficient margin at the distant end to do the work, and while the arrangements employed to overcome the long period of no current and sluggishness of the neutral relay is partially effective, it is better to do away with the causes, which are: First, the long break or period of no current on the line, which causes a bad falling off and a chattering of the armature during reversals. Secondly, the margin between the first and second sides is not enough. Thirdly, the neutral relay, as now constructed, is far from perfect. We have, as a rule, a magnet which, if straightened out, would be nearly four inches long, and is wound very deep with fine wire, whose self induction tends to lag the reversal of its core, and the poor proportion of the winding being also much against rapid magnetization and demagnetization.

To overcome these defects as much as possible was the basis of a dynamo quad that I put on the quotation wire of the Commercial Telegram Company, between New York and Boston, eight months ago. The first side works on 51 volts and the second side on 175. This circuit has been worked both sides every day through nearly all storms and leakages since it started, at the high speed necessary for stock quotations. This shows the gain over other systems. The results obtained are due entirely to avoiding, as much as possible, the causes previously pointed out, and keeping nearly a constant potential to the line regardless of its resistance, and reducing the time of no current to a minimum without any trace of a spark at the pole-changer.

A New System of Cable Transmission.

Judging from results obtained by a preliminary test, recently made, cable telegraphy, which has from the beginning claimed the best endeavors of electricians and inventors, is about to be improved to a very important extent and in a direction long sought for. Mr. Patrick B. Delany, who has been giving the subject attention for the past year, has just perfected an invention by which long cables may be operated by any Morse operator, and by which the received characters are not only greatly improved but the rapidity with which they may be transmitted greatly increased.

It is generally known among telegraphers that the cable operator uses two keys in transmitting—one connected to the positive and the other to the negative pole of a battery—and that dashes are always sent from one key and dots from the other. In actual practice, dots alone are used, but a dot on one key always stands for a dash at the receiving end of the cable, since it swings the siphon-recording pen always to the same side of the middle of the strip of paper; while a dot from the other key always swings the siphon to the opposite side. The object of using dots only is to avoid unequal charging of the cable and consequently unequal discharge of the static from the cable. Thus, when a letter, "b" for instance, — · · ·, is sent into the cable, the first dot, representing the dash, is sent from one key and pole of the battery and is recorded on one side of the centre of the paper strip. The three dots necessary to complete the letter are sent from the other key and reverse pole of the battery, and the delicate recorder is carried to the other side of the strip. These last three dots being from *the same pole of the battery* are recorded as a slightly undulating line with three little hills and valleys, something like the letter "m" in fine manuscript. The distinctness of these undulations depends upon the rapidity with which the dots follow each other into the cable. If sent in very rapid succession they would appear as a straight line and be illegible even to the practiced eye of the cable operator. If a short time is allowed to elapse between them their outline will be clearly defined. It is this tendency of impulses of the same polarity following each other in quick succession to become a continuous current in the cable and make a straight line on the paper that limits the working speed of the cable.

It will be plain, therefore, that if Morse characters could be transmitted with regularly alternating currents of uniform duration the record at the receiving end would be very much clearer, and probably double the number of signals could be sent in a given time. The swing of the recording pen would be greater, the angles sharper, the limit of oscillation of the recording pen uniform, and the tendency of the record to become a straight line avoided. These desirable improvements have been accomplished by Mr. Delany, and an examination of the principle of operation, as illustrated in the diagram, Fig. 1, will show that it not only greatly simplifies cable transmission but brings it to a state of perfection which must largely enhance the working capacity of ocean telegraphs.

It will be seen that the line *L* is connected to the trailing finger *T*, which moves from one segment to another at each reversal of the local current which controls the escape armature of the polar transmitter *P T*, all being under control of the single Morse key *K*. There are three groups or sets of segments in the circle, the battery-connected segments being joined to opposite poles of the main battery *M B*. The intervening segments are all projections from a single plate which is connected through a condenser *C d* to earth. In the position shown the key is up or "open," the armature of the polar relay shown as a receiver at *A* is on the open side, and the trailing finger rests on a segment, which, if the key be pressed down, is put in connection with the positive pole of the main battery. As the key is open there is no current going to line. Now if the key be pressed down the connection to the positive pole of the main battery is first made at the spring contact f^1, but only for a moment, however; for, as soon as the key lever reaches its limiting stop c^1 the local battery *S B*, through the polar transmitter *P T*, is reversed and the trailing finger (line) is moved to the the next battery segment, which finds its battery connection through spring contact e^1 at the back end of the key. So long as the key is held down this negative battery cannot go to line; therefore if the key be held down for the time represented by a dash the armature of the polarized relay at the receiving station, which went to its right hand or "marking" limit when

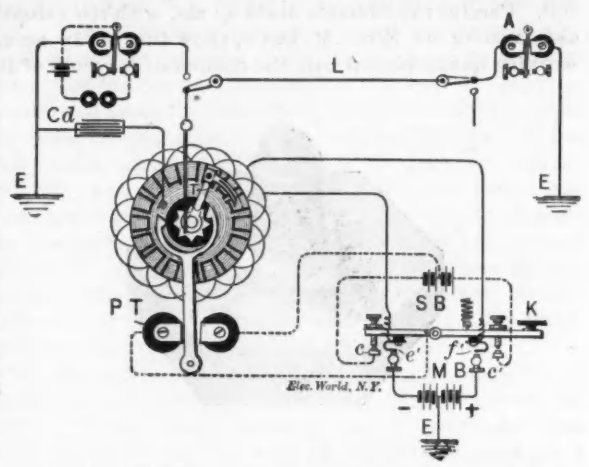


FIG. 1.—AN IMPROVEMENT IN CABLE TRANSMISSION.

the key was *first* pressed down, will remain there and keep the sounder circuit closed; and thus there is a continuous dash, although the line was disconnected from the battery as soon as the key was pressed down to its limit. Or, differently stated, when the key is pressed down a current of one polarity is sent. If it is immediately lifted up a current of opposite polarity is sent, lasting for the short time between the downward and upward movement, forming a dot. If the key be held down a dash is formed, not by the passage of a long impulse, but because the opposite polarity which terminates each signal is deferred until the key is lifted up. One current is the beginning of all signals, the other is the ending; the time between the beginning and the end determines whether the signal is a dot or a dash.

It will be seen that there are no dashes sent into the line, that all currents are of equal duration and alternating in polarity. The trailer transfers the line from one battery segment to the other *in advance* of the movement of the key. In passing from a battery segment to the condenser segment the trailer connects the two together for an instant, thereby charging the condenser with the same polarity of current sent to the line. While the trailer is passing over the condenser segment *alone*, the condenser discharges into the line its induced current of opposite polarity, which meets and neutralizes the static discharge coming out of the line or cable, and thereby leaves the cable perfectly clear for the next signal impulse. The capacity of the condenser is readily adjustable to the discharge from the cable. The duration of contact between the battery and line may be regulated by adjusting the key. If the lever is given wider play between its stops the yielding contacts will put the main battery to line for a longer time.

About a year ago, with an instrument having the trailer propelled directly by the key lever, Mr. Delany made an experiment in England which developed thirty words per minute over an underground cable having 7,000 ohms resistance and 90 microfarads capacity. It was found that for longer cables a longer duration of contact between the battery and line than could be obtained from direct key working would be necessary. In that instrument the battery was connected directly and permanently to the segments and was put to the line only while the trailer was moving across a segment. In the present instrument the duration of the impulse may be made sufficient for the longest cable and the efficiency of the apparatus may be judged by its performance during a rough experi

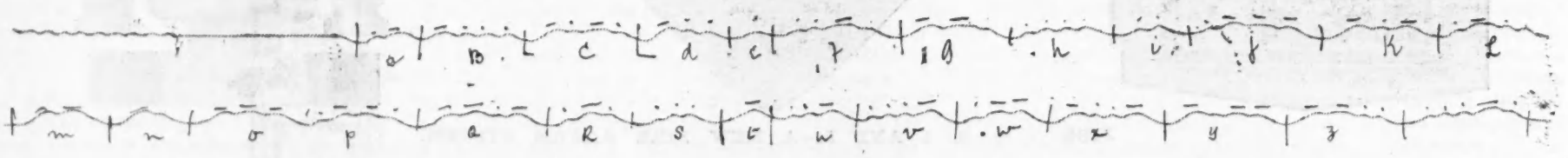
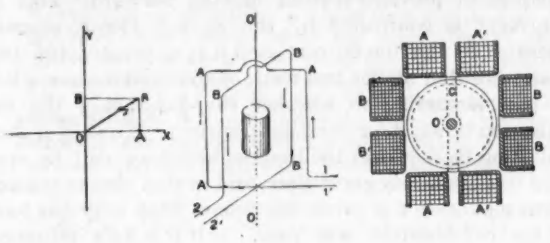


FIG. 2.—FAC-SIMILE OF RECORD MADE BY THE DELANY SYSTEM OF CABLE TRANSMISSION.

ment over a cable within the past month. This cable is 1,000 miles long, with a resistance of 13,000 ohms and a capacity of 900 microfarads.

It is worked with 30 cells of Fuller battery, which, with pole changing keys, is reversed. No additional battery being available at the time, Mr. Delany's instrument was tried with 15 cells (half the usual quantity) for each reversal without much expectation of satisfactory results from so weak a current. The record, of which we give a fac-simile in Fig. 2, proved a great surprise, and shows beyond question that the speed of working over long cables can be greatly increased with diminished battery power. It will be seen that the English Morse alphabet transmitted over the cable is quite plain, even to those unaccustomed to character reading.

The zig-zag line at the beginning shows dots. Their perfect uniformity and distinctness demonstrated clearly the great advantage of regular reversals over the present system.



FIGS. 1, 2 AND 3.—ELECTRO-DYNAMIC ROTATION.

As the cable in question is operated through a condenser, the intermediate or condenser segments of the new instrument were not connected in this experiment and the results obtained were from reversals alone.

A New Quadrant Electrometer.

In an article upon the measurement of high potentials by means of the quadrant electrometer, in the *Centralblatt fuer Elektrotechnik*, Herr A. Voller describes an instrument, designed by him for the purpose, which possesses several points of interest.

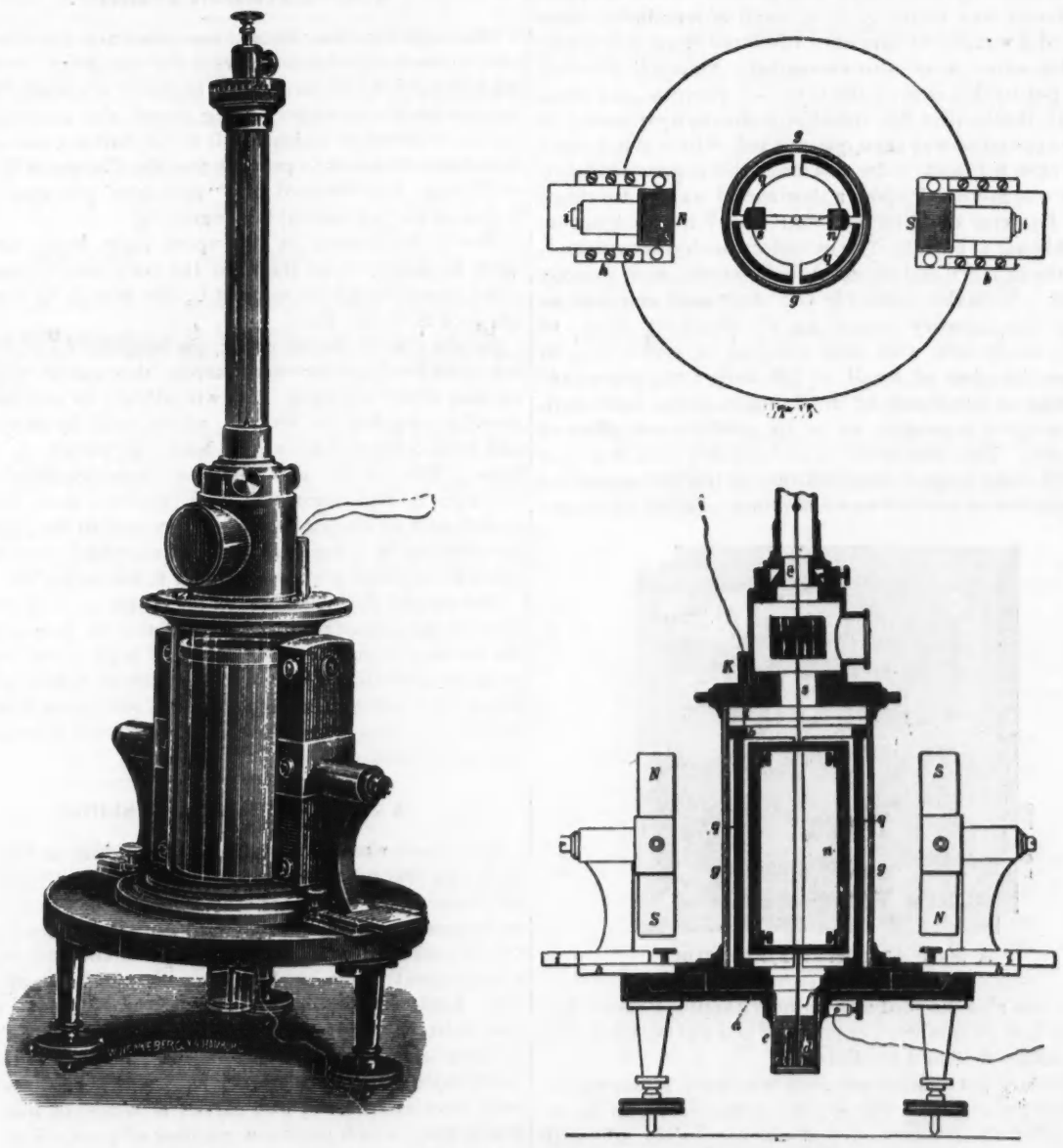
The instrument is shown in perspective in Fig. 1, and Figs. 2 and 3 show the details of construction.

As will be seen, the electrometer has cylindrical quadrants *q*, 13 cm. in length, with an internal diameter of 7 cm. The quadrants are made of a cylinder of sheet brass annealed, finely polished and gilt. They are attached by means of flanges to a hard rubber plate, *a*, and are maintained in a cylindrical position by the upper hard rubber ring *b*. All edges of the quadrants were carefully rounded before gilding in order to prevent the dispersion of the charge. Great precautions were also taken with the screws which held the rings in place. The distance between two neighboring quadrants is .5 cm., and the same are placed at a distance of .2 cm. from the glass cylinder *g* which surrounds them.

The charge is communicated to the quadrants by means of a wire which passes through the cover. This wire, *l*, passes into a rubber stopper placed in the cover at *K*, and ends in a small cavity in the stopper, which is filled with mercury. This affords a hermetic seal, and at the same time allows a good connection with the external wire shown, from which the charge is obtained. In this manner, also, all binding screws are avoided, the use of which frequently gives rise to dispersion on account of the sharp edges of the screws, etc. The connection of opposite quadrants is also effected in such manner as to avoid the dispersion of the charge.

The needle *n* of the electrometer is shaped like that of the well-known Edelmann instrument; but it is constructed of a brass stirrup 12.2 cm. long, 5.6 cm. in diameter, and 1.2 cm. wide. This stirrup is suspended from the mirror by a slender rod *s*, which in turn is attached to the mirror hung from the suspended fibre *c*, the latter being hung from the torsion head at the top of the instrument. The centering of the glass tube through which the suspension fibre passes is not, as usual, effected by means of thumb screws at the base of the instrument, but is accomplished independently by means of the arrangement shown at *c*. The lower cross piece of the frame-shaped needle carries the usual platinum wire, which has at its lower end four vanes, *d*, placed at right angles to each other, which dip into a vessel *e* filled with sulphuric acid, and by which the vibrations of the needle are damped. The connection of the needle with the earth, which is never interrupted while the instrument is in use, is accomplished by means of a strip of platinum *f*, which dips into the sulphuric acid, and connects with the binding screw shown on the under side of the stand.

The damping equipment of the electrometer will be understood from Figs. 2 and 3. Here, it will be seen, the vertical frames of the needle *n* carry on their inner sides bar magnets *N S*, which are maintained in position by thumb screws, and whose number can be added to if desired. The weight of the needle, including both magnets, is 9.68 grams. They are arranged with their opposite poles opposite one another. Outside of the electrometer case there are two stands, which can be slid towards or away from the glass cylinder of the instrument on the slides *h i*, and each of which carries a magnet built up of a number of bars, so as to obtain an even distribution and high intensity of magnetism. The magnets are also adjustable on a horizontal axis. These magnets are employed to vary the sensibility of the needle, and by manipulating them in various ways great sensitiveness or great damping effect can be obtained at will. With this instrument very high potentials can be measured. Thus, by the use of only a single quadrant with the maximum effects of the magnets, a potential of 650 volts deflects the needle one division on a scale 1 meter distant. The permissible potential to which the instrument described can be charged is 5,000 volts, as any excess would cause the spark to strike across between the quadrants. The designer proposes to construct a large one on the same principle.



FIGS. 1, 2 AND 3.—A NEW QUADRANT ELECTROMETER.

Electro-Dynamic Rotation by Means of Alternating Currents.

Professor Galileo Ferraris, of Turin, who, as will be remembered, was one of the first to make a strictly scientific investigation of transformers, and who has since then continued to devote attention to alternating currents, has just published the results of some experiments made with a view to produce continuous rotation by their means. The experiments, says *Industries*, are interesting because the apparatus used was based upon an entirely new principle, which may be capable of further development.

The question how to produce continuous rotation by means of alternating currents is just now occupying the minds of many electricians, because the production of an alternating current motor would greatly increase the earning capacity of the central electric light stations supplying alternating currents.

The principle on which the apparatus is based is exceedingly simple and will be understood by reference to the accompanying sketches. Let in Fig. 1 the lines *O A* and *O B* represent in direction and magnitude the strength of two magnetic fields. The combined action of these fields on a unit pole, placed on the point *O*, would then be represented by the resultant *O R*. Instead of having two distinct fields we have one resultant field, represented in direction and magnitude by this line. If both fields undergo periodic variations of the same period, the resultant field *O R* will also undergo a periodic variation, and the point *R* will traverse a curve, the form of which depends upon the precise manner in which the lines *OA* and *OB* change with the time. The fields *O A* and *O B* can be produced by two coils having the lines *O X* and *O Y* respectively for their axis, and which coils are traversed by alternating currents of the same period. If the alternating currents may be expressed as sine functions of the time, and if there is an appreciable lag between the currents in the two coils, the point *R* describes an ellipse around *O* as centre. In this case the line *O R*, representing the resultant field, revolves round the centre *O*, the direction and magnitude of the resultant field changing at every instant. If, however, there is no lag between the two currents, that is to say, if they pass through zero simultaneously, the direction of the resultant field *O R* remains stationary, and the point *R* performs harmonic oscillations over the line *R O* and its prolongation with *O* as centre. This may be considered as a special case of the ellipse where the latter has been flattened down to a mathematical line. Another special case occurs when the ellipse becomes a circle, and this must evidently take place when the lag between the two currents is 90 degrees, when the coils are at right angles to each other, and when the component fields are equally strong. A metallic body suspended in the centre of the fields and free to revolve must evidently have a tendency to participate in the rotation of the resultant field.

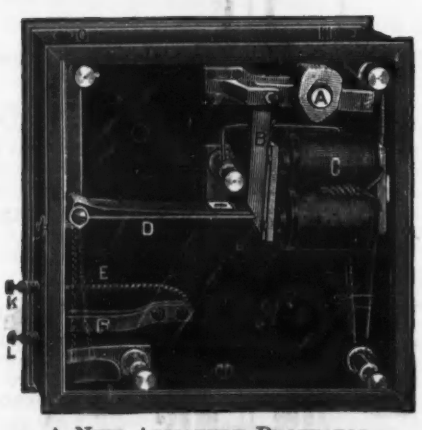
The application of this very simple principle will be clear from Fig. 2, in which the two coils are indicated by the rectangles *A* and *B*, the connnections being made by the wires 1 1′ and 2 2′ respectively. When alternating currents are sent through these coils, a resultant field is produced, which revolves round the line *O O*.

In the centre between the coils is suspended a small hollow cylinder of copper, and as the lines of the resultant field cut the metal Foucault currents are induced, and by the interaction of these induced currents and the revolving field the cylinder is set in rotation. The action is exactly the reverse of that occurring in the well-known experiment in which a copper disc is rapidly revolved below a compass needle, with the result that the compass needle is deflected on account of the induced currents in the copper disc, and ultimately caused to rotate with the copper disc.

Up to the present we have spoken of two distinct currents being required in the coils *A* and *B*, one lagging behind the other by a quarter period; and to perform the experiment we might employ an alternating current dynamo with two circuits in the armature, so arranged with regard to each other as to produce the desired lag. It is, however, possible to perform the experiment by using an ordinary alternating current machine with only one circuit on the armature, and to produce the second current by means of a transformer. The current from the machine is sent through the primary of the transformer and then through the coil *A*, while the secondary current obtained from the transformer is sent through the coil *B*. It is then possible, by the interposition of a suitable inert resistance into the secondary circuit, to obtain very nearly the desired lag of 90 degrees between the currents in the two coils. As the strength of the secondary current will, by the insertion of the resistance, be considerably reduced, it is necessary, in order to obtain

approximately equal fields from the two coils, to employ a larger number of turns in the coil *B* than in *A*. Another method of producing the desired result consists in using a transformer with one primary and two secondary coils, and to insert into the circuit of one of the secondary coils a large self induction, and into that of the other a large inert resistance, by which means the desired lag between the two secondary currents can also be obtained. It will be seen that in either of these ways it is possible, by means of a simple alternating current and a transformer, the coils of which are abreast, to obtain a revolving magnetic field of approximately uniform intensity, by which phenomena can be produced in every respect similar to those obtainable from a revolving permanent steel magnet.

In the first experiment made by Professor Ferraris, a Gaulard & Gibbs transformer with an equal number of turns in the primary and secondary coils was used. In the primary circuit was included the coil *A*, consisting of a few turns of stout wire, while in the secondary circuit were included an adjustable and non-inductive resistance and the coil *B*, the latter consisting of many turns of fine wire. A small hollow copper cylinder was suspended on a thread in the centre of the two coils, as shown in Fig. 2. If the current was sent through only one of the coils, the cylinder remained at rest; but if currents were sent through both coils, the cylinder immediately started to revolve, twisting the thread on which it was suspended. A reversing switch was inserted in the secondary circuit, and if the current through this circuit was inverted, the cylinder was immediately brought to rest and started in the opposite direction. Professor Ferraris next substituted a small iron cylinder for the copper one, and found equal results; but when using an iron cylinder sufficiently large to nearly fill the place within the coils the experiment did not succeed so well. He attributes this to the greater self induction which the presence of iron in a large mass necessarily introduces into both circuits. Another experiment was made with a small iron cylinder, composed of a number of thin discs insulated from each other, and this experiment also succeeded. Foucault currents could not in this case be the cause of rotation, and Prof. Ferraris thinks that the rotation is due to hysteresis. A larger apparatus was then constructed, which is indicated in the sketch Fig. 3. In this case the copper cylinder, which was mounted upon a horizontal axis in bearings, had a diameter of 3½ inches, and was 7 inches long, its weight being 11 pounds. The cylinder was closely surrounded by the primary and secondary coils wound upon wooden bobbins. To make room for the shaft each coil was in halves, the primary consisting of ninety-six turns of seventy-seven mils wire, both coupled in series, so as to produce the effect of a coil of 192 turns; the secondary consisting of 504 turns of thirty-eight mils. wire, both being coupled in parallel so as to produce the effect of 504 turns. The resistance of the primary coils was 7.12 and 6.63 ohms respectively, and that of the two secondary coils coupled in parallel was 3.43 ohms. In the secondary



A NEW ARMATURE PROTECTOR.

circuit was also inserted a rheostat without self induction, and the best results were obtained when the rheostat was set to between 15 and 18 ohms.

A Gaulard & Gibbs transformer was used, giving eighty reversals per second. The copper cylinder began to revolve when the primary current was 5 ampères, and with higher currents the velocity could be increased to 900 revolutions per minute, and might have been still further increased but for the somewhat imperfect mechanical arrangements, which occasioned considerable vibrations. To the shaft was applied a small friction dynamometer, and the following table gives the work obtained on the brake by a primary current of 9 ampères at different speeds:

Revolutions per minute..	262	400	546	653	722	770	772	900
Watts obtained on brake.	1.32	2.12	2.65	2.77	2.55	2 40	2.04	

The maximum energy was obtained at 650 revolutions. Beyond that speed the energy decreased, which is attributed by Professor Ferraris to the imperfect mechanical arrangement of the apparatus, causing a considerable waste of power in vibrations. If it were not for this, the maximum energy would have been obtained at about 1,200 revolutions, whilst at 2,400 revolutions, which is the speed of the revolving resultant field, no energy at all could be obtained. Professor Ferraris suggests that this apparatus may be used for lecture purposes, and as a motor when the power required is small, and it may also be used as an electricity meter. The torque exerted by the revolving field upon the copper cylinder is proportional to the square of the current, and in order that the total number of revolutions performed in a given time may be an indication of the number of coulombs supplied, it is necessary to introduce some opposing force which varies with the square of the velocity. If this can be done, and if the friction of the journals can be sufficiently reduced, an ordinary counter attached to the axis would indicate the quantity of electricity supplied.

Consequent Pole Magnets.

To the Editor of The Electrical World:

SIR: I saw in your issue of May 12 a notice on "Magnets with Consequent Poles." I have a magnet in a star form, with all the points north poles and the centre a

CONSEQUENT POLE MAGNETS.

south pole, as shown in the accompanying sketch. The points were magnetized by "contact" north poles, but the south pole in the centre is a consequent pole, as I understand it.

BENJ. ARNOLD.

EAST GREENWICH, R. I.

A Novel Armature Protector.

Although dynamo-electric machines are for the most part so constructed as to prevent the danger of overheating from abnormal currents, it happens occasionally that unforeseen circumstances bring about the generation of excessive currents which result in the burning out of the armature. In order to prevent this Mr. Chauncey Wright, of Chicago, has designed the "armature protector" illustrated in the accompanying engraving.

The current enters at the upper right hand binding-post *H*, passing from there to the lower one on the same side, then through the magnet *C*, the arm *D*, to the binding-post *E*, to the line.

Should a short circuit occur, the magnet *C* will, by reason of its having a greater current through it, suddenly become much stronger, and will attract its armature *B*, thereby releasing the arm *D*, which will fly downward and form a contact with the hook, as shown in dotted lines. The circuit will now be from binding-post *C* through a resistance coil (not shown), then through switch-arm *D*, shown by dotted lines, out to line, thereby introducing in circuit the resistance, which can be any amount required to prevent injury to the armature.

The weight *A* is movable on the beam, so that the tension on the armature may be regulated in proportion to the current strength. The spring *F* is provided for the purpose of closing an independent circuit which will indicate by a bell and battery when the resistance is thrown on circuit. The resistance coil is connected between the two lower binding posts.

A New Belt Holder and Shifter.

The power wasted in running belts on idle or loose pulleys, and the continual strain upon the belt, makes it desirable that a device for obviating this be employed in many situations. In electric light stations, where the load varies considerably at different hours of the day, such an arrangement finds application. A new apparatus of this kind, known as the "Lightning" belt holder and shifter, and for which Messrs. Willis & Schenck, of this city, are the agents, is shown in the accompanying illustration. As will be seen, a semi-circular frame of iron carries a series of horizontal studs, from which project a number of pins. The movement of the lever in an upward direction shifts the belt by means of the shifter, and at the same time tips the pins so as to allow the belt to fall easily upon it. When the lever is turned in the opposite direction, the pins turn outwardly and stretch the belt to the diameter of the pulley, which takes hold of it at once without a shock. The whole apparatus is constructed of iron and is very compact.

Testing Water.

It has long been known that if a voltameter is filled with perfectly pure distilled water it is imposible to pass an electric current through it. If, however, a few drops of acid, or a small quantity of soluble salt, is dissolved in the water, the current passes and electrolysis takes place. Dr. Carpené has proposed to make use of this fact to determine the quantity of a given impurity contained in water, as experiment shows that at a given temperature a definite quantity of any substance must be dissolved in the water before the current will pass.

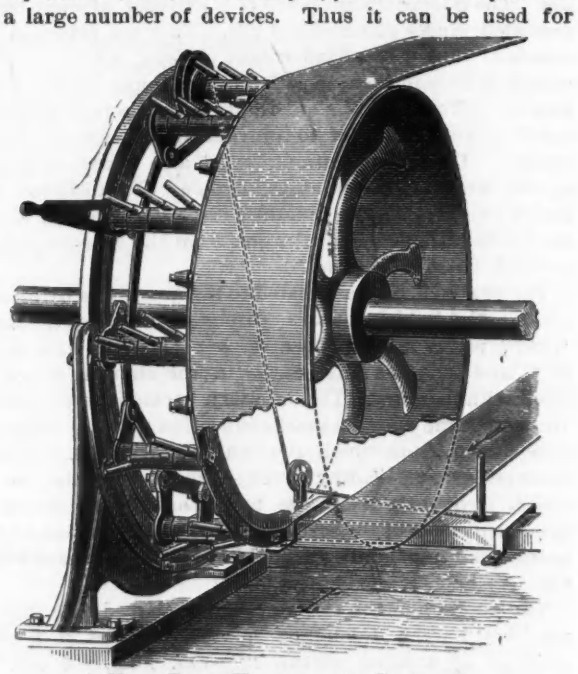
A New Electric Combination Lock.

The controlling of a number of individual stations or points independently of each other on an electric circuit presents so large a field of application that a recent improvement made in this direction deserves attention. The apparatus which we are about to describe and by which this is effected in an ingenious manner, is an electric combination lock which is arranged to be operated or unlocked by a combination of long and short current pulsations, the combination of such pulsations being different for each lock.

The construction of the lock is quite simple and consists merely of two electro-magnets and a toothed wheel which carries the combination in the form of electric contacts, placed between certain teeth. This wheel is propelled in one direction by a spring, and in the other by the action of an electro-magnet operated by a local battery; but an escapement prevents it from moving forward. This escapement is controlled by the second electro-magnet, operated by the line current, and it is so constructed that it allows either one or two teeth of the combination wheel to pass, according to whether the duration of the line pulsation be short or long, respectively. Thus, if a short pulsation be sent over the line the armature will be operated in a relatively short time, and in that case the escapement makes such a quick movement that only one tooth of the combination will pass. If it is a long pulsation, the armature, being attracted by the electro-magnet for a relatively long time, allows two teeth of the combination wheel to escape. In this way there is produced a combination of teeth escapements, so that the final impulse sent brings the toothed wheel to a position in which it closes a local circuit which may be employed to effect a variety of results.

The arrangement is such, however, that the transmission of a single false signal over the line causes the toothed wheel to revert at once to its original position, so that the desired effect cannot be produced unless every signal of the combination follows in proper order; or, in other words, if a number of locks of this description were placed on the same circuit, each having a different combination, the signals sent to unlock one combination would have no effect on the other. Another valuable addition to the apparatus is the return signal which it gives to indicate to the transmitting office or point that the lock has gone into operation.

The inventor of this novel apparatus, Mr. Ed. R. Gill, of Independence, Mo., has already applied it to the operation of a large number of devices. Thus it can be used for



A NEW BELT HOLDER AND SHIFTER.

operating railroad signals from the train dispatcher's office, if need be, doing away with signal men in many instances. Another large application is that in telegraphy for securing absolute secrecy and expediting business on lines which include many offices, such as those in railroad service. Here again the train dispatcher can cut out every office with the exception of the one desired, and by the closing of a local circuit by the lock a call-bell can be set ringing which will at once attract the attention of the operator, who, in many instances, is distant from the key and sounder when called.

Still another application, which, with those already mentioned, we have seen in operation, is the use of the system as an individual call for telephone circuits where a number of instruments are placed on the same line. From the description already given the manner in which this is accomplished will be obvious. Yet another of the uses to which this method of "selecting points" can be applied is that of a police signal system with but a single circuit, which will not only permit the central office to communicate with the patrolmen, but *vice versa* as well.

In warfare its application makes it possible to send secret messages through a large number of offices on the same line. In its application to torpedo work it also permits the placing of a number of torpedoes on the same cable, giving full control of any single one. In this way an individual circuit for each torpedo is avoided, a thing highly desirable.

The Continuous Current vs. the Alternating Current.

The discussion on this subject, which is still continued before the Chicago Electric Club, was taken up on June 4 by Mr. G. H. Bliss, who spoke in favor of the continuous current. While Mr. Bliss disclaimed an intimate knowledge of the alternating system he still thought the continuous presented so many advantages that it would be difficult to replace. Confining himself to the commercial side of the question entirely, the speaker said that when alternating current stations shall have shown the same profit on investment as the direct current stations, it would be time to compare the two. He cited as an example the examination of the books of the first Edison central station in New York, which showed an earning capacity of 8 per cent. on the original investment, in spite of the unusually large cost of this first installation of its kind in the world.

In refutation of the prevailing opinion that the alternating system presents peculiar advantages for small towns or cities with a scattered population, the speaker cited the case of the city of Laramie, W. T., with a population of 6,000. Here an Edison station is supplying 4,000 lights, and up to within a short time realized on lighting business alone a profit of 10 per cent. By the recent addition of motors on the circuits, the profit from this source will probably soon equal that derived from light. Mr. Bliss also stated as a fact that where the Edison stations are run day and night, the current sold for power exceeds the current sold for day lighting, and in many cases it is rapidly growing toward an equality with the entire sale of current for light night and day.

Touching upon the point of the cost of copper, Mr. Bliss stated that in the territory which it is the custom to

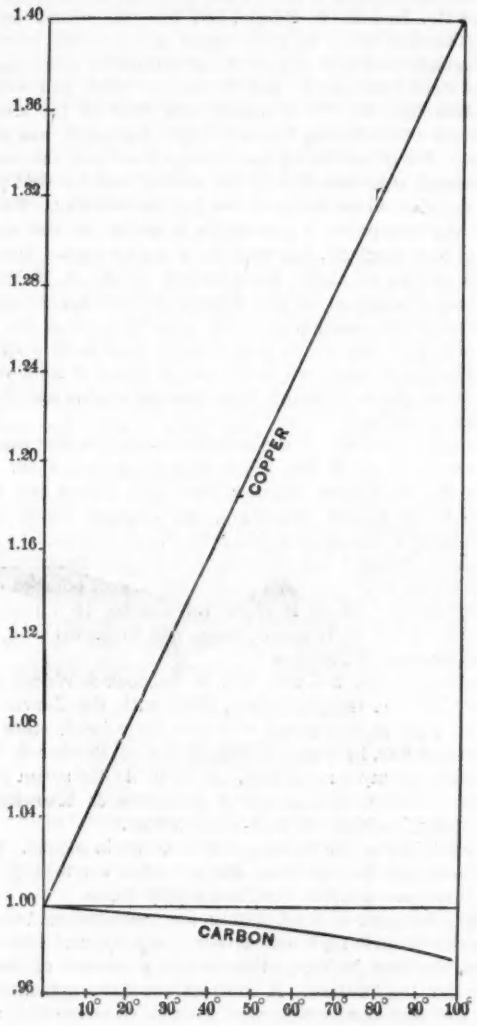


FIG. 1.—COMPENSATED STANDARDS RESISTANCE.

attempt to cover with an Edison system, the cost of copper seldom equals 20 per cent. of the entire cost of the installation. As examples the following cases were cited. For one installation which provides 100 street lamps scattered over an area 1½ miles square and 500 lights for stores, residences and churches in a mile square, the entire cost of copper at 20 cents per pound is $3,000, or $5 per lamp. For another installation where 100 street lamps are scattered in one area two miles square and 800 inside lights in an area about a mile square, the entire cost of copper at 20 cents a pound is $3,102, or $3.44 per lamp.

The speaker emphasized the point that conducting capacity in the feeders and mains is only supplied for the highest number of lamps carried at one time, and yet in any one building all the lights may be in service at once. Therefore, conductors must be supplied for the full lamp capacity.

Thus, on a general Edison installation with conductors for, say, 1,000 lights, 2,250 lamps may be installed in the buildings. Hence the investment for converters from this standpoint would be very great. And when applied generally to city lighting, where only probably one-tenth of the maximum converter capacity would be called for on an average, the investment would be still more disproportionate. Mr. Bliss was also unable to see any special advantage for the 50-volt lamp, which, it is claimed, is specially adapted for alternating work. In his opinion it increased the size of the inside wiring as compared to the 110 volt lamps, and placed that part of the alternating installations in antagonism to the principle which is claimed to be so advantageous in the exterior conductors.

The speaker also took exception to the remarks of former speakers relative to the ease with which the high tension conductors could run underground. He stated that the cost of the heavy insulating material necessary would considerably increase the investment, and that a system of cables drawn in conduits did not offer the best means for distribution.

Against the argument also that the location of a station in a densely populated district entailed a heavy outlay for ground, Mr. Bliss showed that this location made it possible to derive an additional source of income from the sale of exhaust steam for heating. Thus, the Chicago Edison station has a number of applications of this nature.

The speaker concluded with the citation of new rules about to be adopted by insurance companies, bearing on the relative dangers of high and low tension currents.

On Compensated Resistance Standards.*

BY PROF. EDWARD L. NICHOLS, CORNELL UNIVERSITY.

The electrician has few more troublesome corrections to make in the course of his measurements, than those arising from the influence of temperature upon resistance. Were the heating of wires due solely to changes in the surrounding air, the matter would not be a serious one. Such changes could be reduced to a minimum by devices well known in the art of physical measurements, unavoidable changes could be determined by the aid of the thermometer, the temperature coefficient for the various elements of the circuit could be ascertained and proper corrections applied.

Since, however, heat is developed in every circuit in amount measured by the product of the current and the E. M. F. between the terminals, the temperature of a wire through which a current flows is always higher than the surrounding atmosphere. In the case of heavy currents the temperature of the wire may be very high, indeed. The difficulty of applying corrections for temperature is such as to lead to frequent rejection of methods which would otherwise be of great convenience, and might lead to results of the highest accuracy.

The discovery of a substance, the resistance of which would not change perceptibly under the influence of heat, would, it goes without saying, be of great value. Unfortunately all known metals are influenced in the same sense, nor has any alloy been found which is devoid of a temperature coefficient. The exhaustive investigations of the British Association Committee in this field are too well known to need recapitulation, and while some alloys have been recently produced which are much better than anything that committee was able to discover, even these forfeit much of their usefulness on account of their low conductivity.

One substance only, among the solid conductors of electricity, seems to offer a solution of the difficulty. Carbon, as has been shown by Matthiessen,† Siemens, and many later observers, differs from the metals in showing a decrease of resistance with rise of temperature. The amount of this change, which differs widely in the case of the various artificial carbons, is given in the following table:

TABLE I.
INFLUENCE OF TEMPERATURE UPON THE RESISTANCE OF VARIOUS VARIETIES OF CARBON.

OBSERVER.	Variety of carbon.	Temperature interval.	Mean coefficient per deg.
Werner Siemens (*Wiedemann's Annalen*, 10, p. 560)	Gas carbon	0 to 200°	.000345
	Pressed gas carbon	0 to 200°	.000301
Borgmann (*Journal der Russischen Physikalischen Gesellschaft*, 9, p. 163)	Charcoal	26 to 260°	.00370
	Anthracite	20 to 250°	.00265
	Graphite	25 to 250°	.00082
	Coke	26 to 245°	.00026
Kemlein (*Wiedemann's Annalen*, 12, p. 73)	Gas carbon (coarse)	18 to 200°	.000285
	Gas carbon (fine)	18 to 200°	.000287
	Carré's carbons	18 to 200°	.000321
Muroaka (*Wiedemann's Annalen*, 13, p. 307)	Paris retort carbons		.000300
	Arc light carbons		.000405
	Arc light carbons		.000425
	Gaudoin's carbons		.000415
	Kaiser and Schmidt's carbons		.000370
	Heilmann's carbons		.000246
	Arc light carbons		.000156
	Siberian graphite		.000739
	Faber's lead pencil graphite		.000588

The temperature coefficient, while varying widely for different carbons, is very nearly constant for a range of more than 100 degrees, in the case of any given specimen. It seemed probable, in view of this fact, that a conductor might be constructed, by combining carbon with a metal in proper proportions, in which the influence of temperature upon the carbon and the metal respectively would precisely counterbalance each other, thus securing to the combination a constant resistance throughout a considerable range of temperature.

The calculation of the proportions necessary to this result, in the case of carbon, the coefficient of which has been determined, and a given metal, copper for example, is very simple.

Assuming that the combination would be subject to the law of parallel circuits, no alloy being formed, and no chemical combination between the parts taking place, we have for the total resistance R:

$$R = \frac{R_m \; R_c}{R_m + R_c},$$

where R_m is the resistance of the metal and R_c the resistance of the carbon.

The equation of condition, for complete compensation will be

$$\frac{R_m' \, R_c'}{R_m' + R_c'} = \frac{R_m'' \, R_c''}{R_m'' + R_c''}$$

where $R_m' \, R_c'$ are the resistances of the components and $R_m'' \, R_c''$, the corresponding resistances at any other temperature within the limits of temperature for which compensation exists.

Now the variation of the resistance of a metal with the temperature may be expressed by an equation of the form:

$$R_m'' = R_m'(1 + at \pm bt^2),$$

where a and b are coefficients to be determined by experiment.

* Read before the American Institute of Electrical Engineers, May 16, 1888.

† Matthiessen. *Poggendorff's Annalen*, 115, p. 353.

In the case of carbon, the coefficient a will have a negative value, and the equation will take the following form:

$$R_c'' = R_c'(1 - at \pm bt^2).$$

Between 0° and 100° the value of b in the case both of copper and carbon is very small. A recent determination of the coefficients for copper, made in the Physical Laboratory of Cornell University, yielded the equation:

$$R_m'' = R_m'(1 + .00380\,t + .00000047\,t^2)$$

The experiments, which covered a range of 100°, are in close agreement with the results published by Matthiessen.

In the above equation, for $t = 100°$, we have $bt^2 = .0047$. If we neglect the co-efficient b and adopt for a the mean co-efficient between 0° and 100°, we may write the equation in the simpler form,

$$R_m'' = R_m'(1 + .003847t),$$

which will give results agreeing with the complete form at 0° and 100° and will have a maximum error, at 50°, of .0008.

In the case of carbon the coefficient b may also be neglected without appreciable error.

A Carré pencil, measured by another member of the same laboratory, gave as mean coefficient between 0° and 100°, the value .000235.

We may therefore write the equation for this variety of carbon, as follows:

$$R_c'' = R_c'(1 + .000235\,t).$$

The relative influence of heat upon the resistance of copper and carbon is shown graphically in Fig. 1, which diagram will also serve to indicate the nearly constant value of the temperature coefficient of those substances.

In combining copper and carbon in such proportions that the resulting resistance shall be independent of the temperature, the previously stated equation of condition

$$\frac{R_m' \, R_c'}{R_m' + R_c'} = \frac{R_m'' \, R_c''}{R_m'' + R_c''},$$

must be satisfied.

This equation will be satisfied only for a range of temperatures throughout, which $b^2 \, t$ is negligible, in the caser of both substances.

For such a range of temperatures we have, however, as already indicated,

$$R_m'' = R_m'(1 + a_m\,t)$$
$$R_c'' = R_c'(1 - a_c\,t);$$

where a_c and a_m are the coefficients for carbon and copper respectively.

Within such limits

$$\frac{R_m' \; R_c'}{R_m' + R_c'} = \frac{R_m'(1 + a_m\,t)\,R_c'(1 - a_c\,t)}{R_m'(1 + a_m\,t) + R_c'(1 - a_c\,t)};$$

which is readily reducible to the form,

$$R_m'\left(\frac{a_c\,t}{1 - a_c\,t}\right) = R_c'\left(\frac{a_m\,t}{1 + a_m\,t}\right)$$

Using the coefficients already determined for copper and the variety of carbon in question, namely:

$a_m = .003847.$
$a_c = .000235.$

We find,

$R_m = 11.544\,R_c.$

In a word, we must use, for every ohm of carbon, 11.544 ohms of copper in order to secure complete compensation for temperature.

Three methods of combining the copper and carbon in

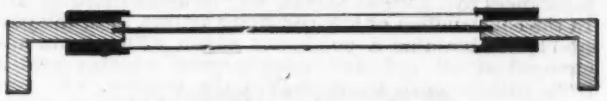


FIG. 2.—COMPENSATED STANDARDS RESISTANCE.

such a compensated resistance have occurred to me as likely to give a good result. The first method consists in wrapping an insulated wire, of the necessary resistance, around the carbon and soldering the ends to the terminals of the bar, previously copper plated for that purpose. The second method consists in mixing the proper amount of copper in a finely divided state with the paste of which the rod is to be made, and then molding and baking the carbon in the usual manner.

In the third method, which is the only one which I have as yet put to actual trial, the carbon, having been tested and its temperature coefficient determined, is electroplated with copper. Experience showed that the film of copper necessary to compensation was so thin as to be scarcely adherent. The following process was therefore substituted for that of coating the entire surface. A Carré carbon 2.95 mm. in diameter was copper-plated for about 5 mm. at each end. The ends were then amalgamated and placed in mercury cups, which formed the terminals of a Wheatstone bridge. The resistance of the rod having been measured, and its mean coefficient between 20 and 100° having been determined, the length necessary for a compensated resistance of one legal ohm was calculated. The rod was then cut to the proper length, allowing 5 mm. at each end for terminals. The ends were heavily plated, and were inserted into the ends of copper rods, which were carefully soldered to the carbon. The rod was then given a coat of shellac, and, when dry, a strip of the varnish was removed with a sharp knife. The strip laid bare was parallel to the axis of the rod, and extended from terminal to terminal. Its width was about 1 mm. The rod was then submerged in a plating bath of sulphate of copper.

In this way a film of copper was deposited upon the exposed portion, which combined the required electrical resistance, 11.544 ohms, with sufficient thicknss to render it tough and adherent. Is was found that one gravity cell, acting through 50 ohms, would deposit the requisite amount of copper for a one ohm bar, in about ten minutes. When the above process had been carefully carried out, the rod was found to have very nearly the proper total resistance and to be nearly perfect in the matter of compensation. If the rod was over-compensated, copper was removed by careful scraping. If it was under-compensated carbon was removed by the same process. These final adjustments were continued until the rod showed no perceptible change of resistance when heated to 100°. When the compensation was regarded as satisfactory, the adjustment of total resistance was made by removing the copper-plating of the terminals, or extending the same by renewed plating. This, if carefully done, would bring

the rod to the proper resistance without impairing the compensation. The rod, after adjustment, was well varnished, and was inserted in a glass tube of about 7 mm. internal diameter. This tube was provided with brass caps, through which the copper terminals projected to a distance of about 5 cm. These, after being securely riveted to the brass caps, were bent through an angle of 90°. When thus mounted the resistance-rod presented the appearance indicated in Fig. 2.

In the manner just described, I succeeded after a few trials in producing a resistance rod upon which the influence of the temperature between 18° and 100° was entirely imperceptible. The object being to test the method of compensation, and not to produce a standard ohm, the adjustment for final resistance was not carried out.

The resistance of the compensated rod, after being mounted, is shown in the following table:

TABLE II.

RESISTANCE OF A COMPENSATED RESISTANCE ROD AT VARIOUS TEMPERATURES; MEASUREMENTS BY MR. GEO. D. SHEPARDSON.

Temperatures.	Resistance in B. A. ohms.
105°C.	1.0300
98°	1.0300
87°	1.0305
35°	1.0305
22.5°	1.0295
19°	1.0300

For the purpose of this measurement, the rod was immersed in an oil bath and heated to more than 100°. The readings were taken while the bath was cooling. They indicate a practically perfect compensation throughout the range of temperature given in the table.

If such a compensated resistance-rod be quickly heated or cooled, the copper will change more promptly than the carbon and the balance will be temporarily destroyed. While in process of heating from without, the resistance will increase somewhat, and while cooling by radiation the reversed effect will be noticeable.

In rods not mounted in glass and unprotected by a coating of varnish these variations are very marked. Table III. contains a set of readings made upon such a rod. The rod was rapidly heated and cooled, and was measured several times during the rise and fall of temperature. The compensation was nearly complete, the mean coefficient between 20° and 100° being less than .00002, but the rod in question exhibited temporary variations when suddenly heated and cooled, amounting to more than one per cent.

TABLE III.

TEMPORARY VARIATIONS OF A COMPENSATED ROD SUBJECTED TO SUDDEN CHANGES OF TEMPERATURE.

Temp.	Resistance.	Temp.	Resistance.
25°	1.0050	78°	1.0030
(Gas ignited.)		(Gas extinguished.)	
37°	1.0072	78°	0.9965
45°	1.0074	74°	0.9960
55°	1.0070	63°	0.9975
62°	1.0040	40°	1.0030
68°	1.0040	25°	1.0050
70°	1.0040		

Compensated resistance-bars, such as have been described in this paper, are of course limited in their application to uses in which carbon conductors are admissible. For standards of resistance I think they will be found especially valuable. The convenience of having a comparison resistance the value of which can be determined once for all, and which can then be used with confidence, without regard to its temperature, even in circuits which would heat our ordinary standard coils and modify their resistances to a notable extent, will be appreciated by all. In the construction of low-resistance shunts, also, the possibility of obtaining a conductor which will remain unchanged at all ordinary temperatures, whether heated from without or by the passage of the current, will permit us to adopt with confidence the use of high-resistance galvanometers, with low-resistance shunts, for the measurement of large currents, even where the highest accuracy is necessary.

To those who, in the course of their electrical work, have to cope daily with the question of the influence of temperature upon resistance, numerous other applications of compensated resistance-rods will suggest themselves.

Improvements in the Quadruplex.

To the Editor of The Electrical World:

SIR: Towards the end of the third part of the article on "Improvements in the Quadruplex," in last week's issue, the interpolation of a sentence in the paragraph relating to a possibly promising "combination of the extra magnet and extended armature, etc.," and the subsequent failure to change the number in the sentence following, confines me unintentionally in that sentence to the last mentioned combination. The sentence should have read, "These latter combinations, etc." WM. MAVER, JR.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, June 4, 1888.

Iron Electric Light Posts.

Mr. J. W. Fisk, Park Place and Church street, manufacturer on a very large scale of ornamental iron work, is making a specialty of iron electric light posts of standard sizes, and with wooden base and iron top, or the reverse. Mr. Fisk has also every facility for making posts from any particular design at the shortest notice.

The Lahmeyer Dynamo.

Mr. E. Imbauser, 206 Broadway, well known for his watchmen's time detectors, bought the patent rights for the United States for the Lahmeyer dynamo, some time since. He has the machines on sale, and has been importing them in all sizes from 30 lights up. These machines have been installed in various parts of the country. One was recently placed in the Potter's Mining and Milling Company's Works, East Liverpool, O., where it is carrying 25 lamps of 32 c. p. at 50 volts, an arc lamp of 45 volts and 8 ampères, and two machines used in separating the iron from the clay for pottery. Mr. Imbauser has another dynamo at work in the Conley Iron Works, Brewsters-on-the-Hudson, running a magnetic separator for abstracting iron from the ore and foundry refuse. Thirty machines are now on their way here from Europe, several of which are already sold, one going to a large electric concern.

Daft Power Service.

The Electric Power Company of New York City has within the last few weeks equipped a distributory electric power circuit by the Daft system on the west side of Broadway, which is exhibiting so healthy a growth as to merit a few words of description. The service is under the management of Mr. Albert Gray; the power station is in the Frank Leslie building at the corner of Park Place and College Place, and its wires extend north and south from Leonard street to Cortlandt street, and east and west from Broadway to the Hudson. Power is distributed in amounts ranging from 1 to 15 horses, and an extensive enlargement of the station and circuit is already in preparation. A new era in dynamic economy has certainly begun.

Experimental Apparatus.

Mr. E. B. Benjamin, 10 Barclay street, manufacturer of chemical and electrical apparatus of all kinds for general and special use, has been renovating and improving his large salesrooms, and has added a number of new features for the benefit of his customers.

The Sprague Motor.

The Sprague Electric Railway and Motor Company have established a city department in the *Star* building, corner Park Place and Broadway, in charge of Messrs. P. W. Dowd and G. W. La Rue. There will be motors of all sizes on exhibition.

Hazaser & Stanley,

of 32 Frankfort street, report a very heavy demand from all parts of the country for their dust-proof bell. Their annunciator, bell, and burglar alarm business is increasing very rapidly, and they will soon need enlarged facilities.

Edson's Pressure-Recording Gauges.

Mr. Jarvis B. Edson has just issued a very tasteful and instructive pamphlet on his pressure-recording gauges for steam, air, gas or water. The pamphlet comprises, in addition to a large amount of interesting matter on the subject, lists of the users of the gauges, among them being a number of electric light companies.

The Electrical Accumulator Company

reports business as very active. A recent contract of more than ordinary interest is for the equipment of 22 cars on the Provincial Railway of the Argentine Republic. Twenty of the cars will have 16 lights each, and two sleepers will have 22 lights apiece. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, June 4, 1888.

Personal.

Mr. John Tregoning, who has been for some time past superintendent of the Mather Electric Company, recently resigned to accept the appointment as superintendent of the Thomson Electric Welding Company's Works at Lynn, Mass.

Mr. Otis K. Stuart, of the Thomson-Houston Electric Company, read a very interesting paper on "Electric Welding" before the members of the Boston Electric Club at the regular social meeting on Wednesday evening, May 30.

Mr. F. A. Rogers, of the Brush Electric Company of Cleveland, O., was on a flying visit to the Hub last week.

Boston Electric Club.

The regular monthly meeting of this organization will be held at its rooms this evening (June 4), and an unusually large attendance is expected. Among the important business to be acted upon is a proposed programme for successfully celebrating the club's first anniversary on June 21.

Tapping Wires.

From the Newburyport (Mass.) *News* I have gleaned the following item: The cause of the partial disability of one of the Western Union wires, which has existed for several weeks, has been discovered to be the tapping of the wire at Hanover, N. H., by a Dartmouth College student and the connecting of it with a local telegraph line. The job was very skillfully done with a mere thread of copper wire, and its detection was very difficult. No motive other than a desire to learn telegraphing by taking regular Western Union messages, and perhaps curiosity, is known.

More Sprague Motors.

Messrs. Sawyer & Blake, New England agents of the Sprague Electric Railway & Motor Company, have received a letter from the East Side Street Railway Company, of Brockton, Mass., from which I have been permitted to quote the following paragraph: "At a meeting of the directors of our company last evening (May 29), it was voted that we use the Sprague system of electricity for propulsion of cars on our road."

Springfield's New Enterprise.

The United Electric Light Company, of Springfield, Mass., has purchased a lot 300 × 150 feet on the river bank, bounded on one side by the New York, New Haven & Hartford R. R., and on another side by the Connecticut River. The railroad company will construct a side track, which will land coal in front of the boilers of the steam plant of the station. Mr. Alex. P. Wright, the manager of the electric light company, has designed his station with a view to the use of compound condensing and condensing engines. He will use shafting for permanent and long-period loads, and will also use condensing high-speed engines belted direct to dynamos. Another mile of underground conduit will be laid, and the entire equipment of the new station, it is expected, will be in readiness to put into operation about the middle of next September.

Massachusetts Institute of Technology.

The graduating exercises of the Institute were held on Tuesday last, in Huntington Hall. The graduating class numbered 77. Among the abstracts read of theses were: Louis A. Ferguson, South Boston, Mass., "The relation of increase of illuminating power to increase of current and energy consumed in incandescent lights;" George L. Heath, Everett, Mass., "Experiments on electrolytic bleaching;" Annie W. Sabine, M. A., Ohio State University, Columbus, O., "The strength of current produced by the microphone, as determined by pressure and material of electrodes;" Charles A. Stone, Newton, Mass., "Efficiency of alternating current transformers.

Plymouth, Mass.

Plymouth was one of the first towns in the State where electricity was used as an illuminant. The Plymouth Cordage Company put in a plant of 50 Weston arc lamps soon after the Weston machines were on the market. The lights still work excellently. Two of the dynamos were burned when the mill was consumed some three years ago. The new mill has an isolated plant of 125 Edison 16 c. p. lamps. Loring & Parks' tack and rivet works are lit by the Thomson-Houston arc system. Eighteen 1,200 c. p. lamps are used. The apparatus was put in last summer.

The Plymouth Electric Light Company uses the Ball dynamos and lamps. Two machines are in use, one of 30 and one of 20 lights. The station is run to nearly its full capacity. Nearly two miles of the main street is lighted by lamps on cranes. The town has just contracted for a total of 17 arc lamps for a year, the price being $2,000. Last year the town paid $1,990 for 14 arc lamps, $890.49 for gas and $225.81 for kerosene and repairs. No motors are in use in the town, but when the company gets its new station built in the rear of the Baptist Church, on Leyden street, it is intended to have a current on the wires all the time. Work on the new station begins this spring. The building will be of brick and fireproof.

Brockton, Mass.

The station of the Edison Electric Illuminating Company, at Brockton, was started in October, 1883, under the personal supervision of Mr. Thomas A. Edison, and has run continuously ever since. This was one of the first central station plants installed in New England, and although in its equipment the best methods of the time were followed, it had to contend with and overcome many obstacles. Mr. W. J. Jenks, now chief of the Municipal Department of the Edison Electric Light Company, was the first manager. Early last spring the management saw the necessity of a thorough reconstruction of the station, and for that purpose placed the plant in the hands of the parent company. The result of their vigorous policy is now visible in one of the best equipped plants in New England, operated on a sound basis. The alteration was carried on under the direction of Mr. J. H. Vail, the general superintendent of the Edison Electric Light Company. The building is a substantial brick structure, 137 × 50, with a heavy mill roof: the engine and dynamo room is 50 × 50. The whole floor space was excavated and a filling of solid concrete 3½ feet deep put in. On this firm base the engine and dynamo foundations are built.

The engines are all of the Armington-Sims make; one, 15 × 14½; two, 14½ × 13; one, 9½ × 12, and one, 8½ × 10. There are two No. 20 Edison dynamos, two type H and two type S; one 32-ampère Edison Municipal, one 50-light American, and two 30-light Thomson-Houston arcs. The comparative system of pressure indication is used on the low tension domestic system, and the wiring and dynamo connections are of polished copper, new throughout. There is space for another 15 × 14½ engine and two more No. 20 dynamos, which will be needed soon, owing to rapid increase of business.

In the boiler room are two 75 h. p. Babcock & Wilcox boilers, and two 125 h. p. tubular boilers, fitted with the Jarvis patent furnace. They are connected with the large brick stack by an underground flue, in which is placed one of Bowker & Tripp's "Matchless" damper regulators. It controls the steam pressure to a nicety. The boilers are fed by Davidson & Knowles steam pumps through a National feed-water heater.

The south half of the building is two stories in height. On the second floor are the spacious offices, meter, arc testing, photometer, lamp, and general work and supply rooms.

Early in the process of rebuilding the management bought out the Jenney Electric Light and Power Company, and moved their plant to the new building, thus securing control of the entire electric lighting business. A contract for lighting the streets by the Edison Municipal system was secured from the city, and the plant installed last summer. It was started in September, and has run successfully ever since, giving entire satisfaction to both the city and the Illuminating Company. There is now not a single city gas or oil lamp on the streets. The lighting is done by 25 arc and 470 municipal lamps of 15, 20 and 30 c. p. The station runs 24 hours daily, and there are many motors connected. One of 10 h. p. runs the principal printing-office, operating two large double presses, an elevator, and also distributes power through the building by a line of shafting. Motors of from ⅓ to 10 h. p. are being frequently connected for running printing-offices, shoe factories, etc., etc. The officers of the company are: Charles G. White, president; W. L. Garrison, treasurer; Z. C. Keith, manager, and George W. Palmer, Jr., superintendent.

Bath, Me.

The new steam yacht "Sagamore," Mr. John W. Slater, owner, now nearly completed, has been equipped with an Edison plant, the details of which are intended to be the "acme" of marine installations, consisting of a special high speed engine (390 rev.), built by the New England Iron Works, an Edison No. 2 dynamo (capacity, 75 16 c. p. lamps), and a complete outfit of accumulators from the Electrical Accumulator Company. Fixtures of the most elaborate design and finish are furnished by the Thackara Manufacturing Company, of Philadelphia. The greatest convenience and safety are secured by a division into nine separate circuits, all controlled by the engineer at the dynamo. Inconvenience and danger are still greater reduced by controlling each and every light by a safety plug of its own in such a manner that they can be renewed at a moment's warning. In case there are several lights in a room, each one, when possible, is taken from a different circuit, so that the room will never be in complete darkness, except in case of a total break down, which, however, can hardly occur. There are no fuses inside of state rooms, all safety plugs of individual lights being grouped in accessible places or "centres of distribution." Every switch is in the engine room at the dynamo, excepting, of course, the key for each individual socket or lamp-holder. No circuits can be thrown on or off except by the engineer in charge. Electric signals from different parts of the ship lead into the engine room, thereby informing the engineer of the owner's wish concerning the different

circuits, etc. Messrs. Buehler & Bateman, the well-known marine constructors, who installed the plant, have spared neither labor nor expense to make this installation a model of marine work. The same firm have also installed on this vessel a complete outfit of annunciators and electric signals of the latest improved pattern. The entire electric outfit is now in operation and gives the greatest satisfaction. The "Sagamore," or "Bath Beauty," as she is called there, is about to start on a trip around the world, and for equipment, finish, speed and grace, is second to no yacht afloat in American waters. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., June 2, 1888.

Horn, Brannen & Forsyth.

The Horn, Brannen & Forsyth Company have just finished a large contract for the new Union Depot at Indianapolis, and have also finished the fixtures for the handsome new building of the Land Title and Trust Company at Sixth and Chestnut streets, in this city. Both of these structures were supplied with handsome fixtures, partly combination and gas and electric light mixed. This firm report business much better than usual at this season of the year.

Reading, Pa.

A special dispatch from Reading, Pa., says: "The contracts heretofore awarded for lighting the streets of this city having been declared illegal by the court, Councils met in joint convention last night for the purpose of awarding the new contracts, for which proposals had been invited. Gas and naphtha lights had no show, for after an exciting debate it was decided, by a vote of 30 yeas to 10 nays, that the whole city, from centre to circumference, should hereafter have the benefit of electricity. The Reading Electric Light Company was awarded the contract for 150 arc lights, to be increased at any time not exceeding 250, to burn all dark hours, at $85.60 per light per annum; and for furnishing from 500 to 700 incandescent lamps at $14.98 per lamp per annum. It is supposed that it will take the company about two months to get all the lights in operation."

An Electric Fire Arm.

Mr. J. K. G. Gavitt, who is connected with the firm of Cornelius & Rowland, of this city, has received a patent for an electric fire arm. The device can be attached to any weapon, but it is intended principally for magazine rifles, and it is extremely simple. A small storage battery is placed in the stock of the gun, and with insulated wires connected with the breech plate a current sufficient to explode the cartridge is transmitted. It is said that fully five thousand shots can be fired with one charging of the miniature cell.

Stock Exchange Wires.

A special meeting of the Stock Exchange was held last week to consider the proposition of the Governing Committee to remove the telegraph office from the floor of the new Stock Exchange headquarters. Such a change would seriously interfere with the arbitrageurs who transact business in the Exchange. They came to the front at the meeting, and the proposition was defeated by a vote of 38 to 41. The telegraph offices will therefore remain on the floor of the Exchange, directly beneath the galleries.

E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, June 2, 1888.

The Thomson-Houston Company,

among recent orders report the sale of 50 arc lights for increasing the city plant at Madison, Wis. They also report the sale of an isolated plant to the Menominee Bay Shore Lumber Company at Menominee, Wis. The Capital City Gas Light Company, of Des Moines, Ia., have also given their order for 70 arc lights for increasing the city plant.

The Thomson-Houston Company report also having sold 100 arc lights to the Crawfordsville Gas and Electric Light Co., Crawfordsville, Indiana, to be used in lighting the city, also an isolated plant of 800 incandescent lights for the Hotel St. Louis, Duluth, Minn.

Personal.

Mr. E. S. Sanderson, general Western traveling agent of the National Carbon Company, of Cleveland, O., was in the city this week. He reports the prospects of business in his line good.

The National Electric Construction Company

recently moved into new and pleasant quarters at 42 La Salle street. They will do a general line of wiring for all electrical purposes. They are also agents for Cook County of the Applegate burglar alarm matting.

Rope Transmission.

The Union Steamboat Company of this city recently put in their freight warehouse, corner of Washington and Market streets, some loading and unloading tramways to be used in conveying freight to and from vessels and warehouse, and also some barrel elevators to hoist barrels from the basement to the tailboard of city wagons. These machines are located in widely separated parts of the building and the problem of transmitting the power to each machine was one of importance, and the subject was studied by electric motor men with considerable energy. The warehouse is to be lighted by incandescent lights and the distribution of power by electricity seemed quite advisable. The Link Belt Machinery Company put in the hoisting and conveying machines and they recommended a manilla rope transmission, and it was put in and tested, with very satisfactory results.

Mr. T. S. Miller, of the Link Belt Company, designed the transmission, and great credit is due him for the success of the plant. The principle employed is similar to the cable as used in street railways. The cable used is a manilla rope ⅞ inch in thickness and 750 feet long. The rope after going around the driving wheel and winding sheaves three times is carried 150 feet north on 12 inch pulleys. There it furnishes power to a moving incline and then is carried 200 feet south and thence eastward 75 feet, where it drives a barrel lift; 80 feet southward it furnishes power to another barrel lift and thence returning to the driving wheel, where it moves a second incline. The slack in the rope is taken up by a sliding wheel on the same principle as on the street car cable. Mr. Miller thinks the rope transmission will be the electric motor's most formidable rival. It certainly has the advantage of great flexibility and efficiency, and doubtless within its scope will give, in some places, the electric motor a hard push, and in many cases it will probably be used to good advantage in connection with the motor.

The Cushman Telephone Suit.

The trial of the telephone patent case of the American Bell Telephone Company, against the American Cushman Telephone Company, was begun before Judge Blodgett yesterday, June 1.

A New Corporation.

The Electro-Carbon Motor Company, Chicago, received license this week from the Secretary of State to incorporate for the purpose of manufacturing and selling motors for surface, underground, and elevated railways; capital stock, $1,000,000; incorporators, E. B. Hamlin, A. H. Meaton and J. B. Payne.

Fort Wayne Jenney Company.

The Chicago office of the Fort Wayne Jenney Electric Company, W. J. Buckley, manager, has recently been removed to 225 Dearborn street, where they will occupy very pleasant offices.

United States Plants.

In the "résumé" of the installations made exclusively by the Western department of the United States Electric Lighting Co., which I gave last week, it should have been stated that the total given of about 30,000 incandescent lights and 200 arc lights, was simply for installations made from Jan. 1, 1887, to date. Mr. C. C. Warren, the manager, informs me that since locating here the Western department has installed in all between 90,000 and 100,000 incandescent and over 3,000 arc lights. He also informs me that since May 16 of the present year his department has closed contracts for 3,370 incandescent and three plants of 20 arc lights each. These bare figures give a striking idea of the importance of the Western agency.

An Electric Combination Lock.

The Gill combination lock, for telegraph and telephone lines and special railway work, is controlled by Col. A. W. Jones, the president of the Independence, Mo., Electric Light, Heat and Power Company, to whom all communications in regard to it should be addressed. The lock is to be placed at once for signaling uses on the Kansas City, Fort Scott & Memphis Railroad. It also goes on the Pacific Mutual Telegraph Line and will be tried on the patrol and fire systems of Kansas City.

Leonard & Izard,

Agents for the Edison United Manufacturing Company, and constructors for the Edison Electric Light Company, have moved into their new and elegant offices at the new Rookery building. This building, which is one of the finest of its class in the country, is being installed by this company with incandescent lights, and when completed will be one of the largest isolated incandescent plants in the world. In the basement of the building the company will occupy considerable space for store room, testing department, repair shop, etc. They will keep on hand a full stock of every kind of apparatus used in the Edison electric light system aside from the dynamo. The many advantages of carrying a complete stock of apparatus, having repair shops, etc., is apparent. Wiring for the 2,500 temporary lights for lighting the auditorium during the Republican National Convention is nearly completed and lights will be started about the 10th of June. Two No. 30 dynamos will be required in this plant, with two 100 horse-power Ide engines.

Coal Handling Machinery.

I am in receipt of a neat little pamphlet, the compliments of John O. Keim, shipping and freight agent of the Philadelphia & Reading Railroad Company, describing the coal handling machinery used by that company at Port Richmond, Philadelphia. The subject of handling coal for central stations and other large plant use is of great interest to electrical people. This machinery was erected by the Dodge Coal Conveyer Company, of Philadelphia, having been constructed for them by the Link Belt Machinery Company, of Chicago. The circular gives a brief account of the operation and advantages of the new system in use at Port Richmond, and among the advantages claimed is increased storage capacity (in practice the results given show that the storage ground whose maximum capacity was 30,000 tons, has been made to accommodate nearly 100,000 tons of coal), prompt release of cars, economy, etc.

Muncie, Ind.

A correspondent writing from Sandusky, Ohio, sends me the following:

Of the many electric light stations that it has been my pleasure to visit throughout Ohio and Indiana few are better arranged or neater kept than the station at Muncie, Ind. The company are operating 1,000 incandescent lights of the Edison three-wire system from four Edison dynamos of 250 lights each. The plant also includes a 5 ampère 25 light Ball dynamo and a 30 light Brush, driven by two Ball engines 180 and 150 h. p. (high speed).

Natural gas is burned under the boilers from two gas-wells owned by the company and costs them practically nothing. The boiler-room is as clean as the office, coal and ashes having been done away with, and the coal shovel that was used before gas was introduced is now hung high from the ceiling of the fire-room with the inscription painted thereon "laid to rest." The fireing of the boilers requires no attention, as the quantity of gas admitted to the furnace is automatically controlled by the "regulator," and maintains the steam pressure constant to one pound, even with extreme variations of load.

The station is in many respects a model one. Much credit is due Mr. J. A. Singleton, the night engineer, for the general cleanliness and for the courtesy displayed by him in showing visitors around. Mr. Singleton is also an able electrician.

Dallas, Tex.

A correspondent at Dallas writes me as follows: Texas is "booming" (if I may be allowed to use that much tabooed word) in the electrical way, more work having been done in that line in the last year in proportion to the population than was done in any other State. The various companies find it very profitable to keep a man in the field. Parker, of the Brush Company, has his headquarters in Dallas, and reports business unusually good. Richards, of the Thomson-Houston, is faithfully devoting himself to the interests of his company. Messrs. Gates & Cronise, of the Westinghouse, are making many sales. Clower & Harris report the sale and erection of a 300 light Edison plant for the Baylor Female College, at Belton, Tex., which was completed May 5, and which is giving them great satisfaction (as the business manager of the college expresses himself in a letter to them a few days since), the "new" 31 watts lamps being used; also the closing of the contract for a 300-light Edison plant at the St. Mary's College in this city, which is to be a very complete plant, including fixtures; also the wiring of the Dallas Club building for 100 incandescent lights, a No. 30 annunciator, with return call and fire alarm attachments; and a number of residences and buildings being wired for lights, burglar alarms, annunciators, etc., including Mr. Alex. Sanger's residence for 46 lights, burglar alarm, annunciator, etc.; Dr. E. M. Tillman's residence, 20 lights, annunciator, etc.; Grand Windsor Hotel, elevator call, and so it goes on. Henshaw & Co. report business good and very encouraging. The Electric Light, Power and Manufacturing Company has again changed hands, Mr. L. Craddock having disposed of his interest to Mr. Seth Miller, who retains the positions of president and general manager. It is the intention to enlarge the plant, and $40,000 will be expended to make it one of the finest in the State.

The Queen City Electric Light Company, composed of local capitalists, have applied to the Council for a franchise, and announce their intention of starting in first class style. The Thomson-Houston Company is backing them and they will no doubt succeed.

Mr. H. M. Sutton, a young local inventor in the electrical field, has completed his labors and will give a public exhibition of the Crowdus-Sutton system of arc lighting in a few days.

The Dallas Electric Light and Railway Company are using their best efforts towards the completion of the electrical railway at the coming Dallas State Fair and Exposition, in October.

The Brush Company at San Antonio had a very lively experience a few evenings since that deserves to go on record. During a terrific storm lightning struck a pole a short distance from the station, destroying it completely and melting the circuit. It naturally followed the same into the station, and, strange to say, melted the commutator away without materially damaging the rest of the dynamo. Those in charge took it in hand, and in exactly 92 minutes, or 1 hour and 32 minutes from the time the bolt entered the building, the machine was running and the lights burning again. This may be counted as pretty good evidence of the ability of the persons in charge when it is remembered that the entire machine had to be dismounted, the armature taken out, as well as all the sections, and replaced by new ones, the old burned commutator taken off and a new one substituted, and the circuit repaired, all in 92 minutes. It speaks volumes.

The Westinghouse Company have sold a plant at the State Penitentiary at Rusk, Texas.

Omaha, Neb.

A corespondent writes me that the Omaha & Grant Smelting and Refining Works, which have had in operation for some time an electric plant consisting of arc lamps in series, propose to substitute about 300 Edison incandescent lamps, 16 candle-power each, for same. The work is under way at present, but will not be completed for some time. It is proposed to construct a central station electric light plant, costing some $500,000, which will include South Omaha. It is understood that local capitalists and others are interested.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$27@	$28
Central Union	47@	48	Michigan	79@	80
Chicago	375@	400	Missouri and Kansas	70@	71
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	65@	68	Wisconsin	108@	109
Great Southern	35@	40		E. L. P.	

THE TELEGRAPH.

Rockland, Me., is to have a fire-alarm system put in by the Gamewell Company.

Middleton, Conn., is to have a fire-alarm system, which will include a number of factories in its operation.

Duluth, Minn.—The Duluth American District Telegraph Company has been incorporated by T. R. Anson and others, with a capital stock of $10,000.

Postal Telegraphs.—Mr. Raynor, chairman of a sub-committee on telegraphs of the House of Representatives, has written to Mr. Powderly promising to push the measure for postal telegraphs with all the zeal he can command.

T. M. B. A.—Assessment No. 218 for June, for $1, has been made to meet the death claims of J. F. Farrell, F. G. Cadwallader and J. J. Fuller. Assessment No. 18, in the second division, for $1, is for the claim of S. B. Morse.

Boston Mutual District Company.—At the annual meeting of the Mutual District Messenger Company of Boston last week the following gentlemen were chosen directors: Frederick L. Ames, James M. Prendergast, Allen S. Weeks, Thomas Roche, Otis Kimball, D. J. Hern and Parker C. Chandler, of Boston, and Charles A. Tinker and Thomas T. Eckert, of New York. Mr. Weeks was chosen treasurer and clerk.

The Isthmus Telegraph.—The Central and South American Telegraph Company's surveying staff is now engaged in locating its proposed telegraph line across the Isthmus of Panama, the company having secured from the United States of Colombia the necessary concessions for operating a line. The obtaining of these concessions is owing largely to the demand of the United States government, the telegraph company having been opposed by the Panama Canal Company. It is thought that any further resistance on the part of the canal company will raise serious international questions.

Great Western Telegraph Company.—A special dispatch of May 29, from Chicago, says: Elias R. Bowen, Receiver of the Great Western Telegraph Company, received a verdict for $875 in Judge Clifford's court to-day against A. J. Hoagland, a Board of Trade man who was a stockholder in the company. Th

result of the trial, which lasted three days, affects 2,000 other stockholders. The Great Western Telegraph Company being insolvent, a Receiver was applied for in 1874 and the company wound up. Elias R. Bowen was the Receiver appointed, and he found that the company's assets were less than sufficient to satisfy the claims of the creditors. Application was made to Judge Tuley to fix the stockholders' liability, and, after considerable fighting, a decree was entered assessing all of the 2,000 stockholders 35 per cent. of the par value ($25) of each share of stock. The Receiver was authorized to bring suit against each individual stockholder, and about 50 suits were begun, and actions against the remainder were deferred to ascertain the outcome of that against Hoagland. His case is the first tried, and the $875 verdict represents 35 per cent. of the par value of 100 shares of stock. Hoagland had already paid $1,000, but many of the 2,000 stockholders had never paid a cent. The indebtedness of the company amounted to $400,000.

THE TELEPHONE.

Oshkosh, Wis.—Mr. M. E. Dorsch has introduced the "Little Magnet" acoustic telephone in Wisconsin.

Tennessee.—The receipts of the Cumberland Telephone and Telegraph Company, during the year ended March 31, were $188,714.42, and the expenditure was $111,574.19, leaving a net income of $77,140.23.

THE ELECTRIC LIGHT.

Oberlin, Kas., is to vote on issuing $30,000 bonds for electric light and water-works.

Harrisburg, Pa.—The Excelsior Company has secured the new contract for lighting the city.

New Bedford, Mass.—The Westinghouse plant of the New Bedford Gas Light Company is now in operation.

Shamokin, Pa.—A lighting stroke is reported to have damaged the electric light plant at Shamokin last week.

Newburgh, N. Y.—The sale of the plant of the Newburgh Electric Light Company has been adjourned until June 28.

New York City.—The Manhattan Electric Light Company has been incorporated by A. Smith and others, with a capital stock of $100,000.

Kansas City, Mo.—The general office of the Kansas City Electric Light Company has been moved to the National Bank of Kansas City building.

Salem, O.—The Salem Fuel, Gas and Electric Light Company has been incorporated by J. T. Brooks and others, with a capital stock of $200,000.

Elizabeth, N. J.—It is reported from Elizabeth that during a thunderstorm there last week, one of the arc light wires "exploded," throwing off temporarily a number of lights in the upper part of the city.

Urbana, O.—The committee of the Urbana Council, with Mr. W. J. Harris, chairman of the Lighting Committee, have visited Lima, O., to inspect the Silvey system. A company has been formed in Urbana which has made a proposition to the City Council to light the place, using Silvey dynamos and lamps.

Red Bank, N. J.—Through the enterprise of Mr. D. H. Applegate, a public-spirited citizen, Red Bank has a Heisler central station for incandescent lighting. A large amount of commercial lighting is done, and 70 street lights of 30 c. p. each, at the rate of $24 each per year, are furnishing illumination on 6 miles of streets

Orange, N. J.—Mr. R. B. Suckley, who recently established a Heisler incandescent plant at Orange, N. J., has just ordered from Hyer & Montgomery a Heisler dynamo of 125 lights to illuminate his summer residence, stables, boat-house, grounds, etc., at Rhinebeck, N. Y. The machine will be run by water power.

Fire in Boston.—On Saturday morning, June 2, the Boston Edison station, in Head Place, was visited by a severe fire, said to have originated in an "equalizer" box. The damage done to the station and apparatus is estimated at about $50,000, covered by insurance. The destruction of the station has temporarily cut off supply to the system from that source.

Wabash, Ind.—The construction of the Heisler central station at Wabash for lighting the city with incandescents is progressing rapidly. Pole line and circuits on nearly 12 miles of streets have been put up, and it is expected that the plant will start at once. The remarkable feature about this plant is that it is to replace a system of arc lights on towers, and as far as we are aware is the first case of the kind.

Sioux Falls, Dak.—The Cascade Milling Company, J. Emerson, President; E. A. Sherman, Vice-President; G. E. Wheeler, Secretary and Treasurer, and O. Ericsson, Electrician, has a plant of 500 Edison incandescents and 30 Van Depoele arcs, which has been running successfully at full capacity since last October. It is stated that, singularly enough, the local gas works have blown up twice in the same period, with great damage.

Ball Engines.—The Ball Engine Company, Limited, of Erie, Pa., have received the contract for furnishing the complete steam plant for the reorganised Paterson Electric Light Company, at Paterson, N. J. This will include two 100 horse-power engines and three 125 horse-power boilers. A steam plant will shortly be shipped from the works of the Ball Engine Company to the Rome Gaslight Company, at Rome, Ga., for the Thomson-Houston Electric Company, of Boston.

Philadelphia.—The Enterprise Electric Company, of 55 South Third street, Philadelphia, have just completed the wiring of the large building of Wm. A. Haines, at 137 North Seventh street, for electric lighting. They use the Edison dynamo, Julien storage battery and Sawyer-Man lamps. This firm also have large contracts at Sea Isle City, among which are the Continental Hotel and several large private residences. They are also fitting up with electrical appliances two cottages for Nelson F. Evans, at Bradford Hills.

Playing at Miracles.—The Texas *Baptist and Herald* mentions the fact that an Edison plant of over 100 lights, driven by a Westinghouse engine, has been installed in the Baylor Female College by Messrs. Clower & Harris, at Dallas. At the inaugural exercises one charming young lady sang, "And darkness was upon the face of the deep," whereupon all the lights went out. Then from the darkness sounded the solemn command, "Let there be light!" whereupon all the lights popped up again. There were loud applause and demands for an encore.

New York City Contracts.—Under the decision of the corporation counsel contracts have been awarded to the lowest bidders as follows: Brush Electric Light Company, 44 lamps at 35 cents a lamp a night; East River Electric Light Company, 211 lamps at 35 cents; United States Electric Light Company, 270 lamps at 35 cents; Ball Electric Light Company, 48 lamps at 27½ cents; Mount Morris Electric Light Company, 61 lamps at 30 cents; Harlem Lighting Company, 49 lamps at 50 cents; North New York Lighting Company, 33 lamps at 35 cents.

Utica, N. Y.—The first mortgage 6 per cent. 5.20 bonds due 1908 of the Utica, N. Y., Electric Light Company are being offered for investment purposes by a firm of bankers of this city. The interest and principal are payable through the Central Trust Company, New York, the trustee of the mortgage. The bonds are in the denomination of $500 and $1,000. The company mentioned have a very fine plant of the Fort Wayne Jenney system, and have a city contract for three years with the city, at $42,000 per year, besides a large amount of commercial business.

Pittsburgh, Pa.—Stern & Silverman, representing the Edison system, report business as quite active. They have just completed a 500-light plant for the *Daily Dispatch* building, a 150-light plant for the *Leader* building, and a 235-light plant for the Groetzinger building. In addition to this they were awarded a contract for the lighting of the Gusky building, which covers an entire block. The plant will consist of two No. 16 Edison dynamos, 100 h. p. Beck-Taylor engine, and wiring for 1,000 lights. They have also been awarded the contract for the Fleishman building, 35 2,000 c. p. light plant, American system, and 50 h. p. steam plant of the Beck-Taylor make.

Mayor Hewitt and the Wires.—At a meeting of the gas commission last week, Mayor Hewitt improved the occasion to say that in the present excited state of the public mind regarding the electric light wires, it was for the board to determine whether it would authorize the stringing of any more wires on poles. The Mayor thought the danger was exaggerated. He had investigated the subject and found that there were 7,000 arc lights in the city, and from these there had been only four accidents, two of which were to employés of the companies. In each case death occurred from the distributing wire, and not the main one. He thought the percentage small. All public improvements had been opposed.

The Taylor Manufacturing Company, of Chambersburg, Pa., builders of the "Beck" automatic engine, who make a specialty of the manufacture and erection of complete steam plants especially for electric light service, report the following recent sales: A 100 h. p. steam plant for electric light station at Coldwater, Mich.; complete steam plant of 100 h. p. Beck automatic engine, boiler; etc., to be erected for the Consolidated Street Railway Company, of Columbus, O., to operate the electrical railway of the Sprague system that they are installing; complete steam plant, consisting of two 120 h. p. Beck engines, two 150 h. p. return tubular boilers, etc., to the Schuyler Electric Company, for their plant at Hagerstown, Md.; a 67 h. p. Beck engine, with boiler, etc., making complete steam plant, for the Thomson-Houston station at Frederick, Md.; a 57 h. p. complete steam plant for a Thomson-Houston station at Reidsville, N. C.; a 7 × 8 Beck automatic engine, to run dynamo at the Hotel Duquesne, Pittsburgh, Pa.; also a 15 h.p. vertical automatic engine, on combined base, with a dynamo, to go to Port Huron, Mich. The company also report numerous other sales of their horizontal automatic engines for general service, flouring mills, planing mills, manufacturing concerns, etc.

APPLICATIONS OF POWER.

Salem, Mass.—The Naumkeag road is to have a Sprague system.

Sacramento, Cal.—The Sacramento electric road is to be ready by September.

St. Louis, Mo.—The Cass Avenue and Fair Ground Railway proposes to adopt electricity.

Steubenville, O.—The Sprague Company has closed a contract for an electric road at Steubenville, O.

Export Trade.—The Sprague Company have just received orders for a number of their motors to be shipped to Paris.

Pasadena, Cal.—Painter Bros., of Pasadena, Cal., will substitute electric motors for the engines on their dummy line.

Syracuse, N. Y.—The Third Ward Railway is to be equipped for operation by electricity by the Thomson-Houston Company.

Seattle, Wash. Ter.—The Seattle Street Railway Company is to issue bonds for $60,000, in order to change over to electricity.

Fresno, Cal.—About $30,000 has been subscribed for an electric road at Fresno, to be operated by the Julien storage system.

Buffalo, N. Y.—The Buffalo Street Railway Company have ordered a storage car from the Electric Car Company of America, Philadelphia.

Newark, O.—Mr. R. Cunningham holds a franchise for the electric road to be built between Newark and Granville, a distance of six miles.

Auburn, N. Y.—Harris Bros., the street railroad builders, who have control of the Auburn City Railway Company, will, it is said, adopt electricity.

North Adams, Mass.—The Hoosac Valley street railway has been bought by Thomson-Houston representatives, it is said, who propose to convert it into an electric railway.

Ironton, O.—The Ironton & Petersburg Street Railway will probably adopt electricity. The chief stockholders are: H. Burkholder, of Chicago, and M. W. Conkling, of New York. The road is now in course of construction by W. M. Hewitt, of this city.

Quincy, Ill., is talking of putting in a cable road, but local electricians rightly think that motors would be better. The opportunity for electric motors there ought to be good.

Baxter Motors.—Mr. T. McCoubray, Jr., reports the demand for Baxter motors very active. Some of the testimonials he has lately obtained from New York purchasers are remarkably strong and emphatic.

Hartford, Conn.—The City Railway Company proposes to operate by electric motors on Asylum a venue, and the Hartford and Wethersfield Horse Railroad Company has applied for permission to change from animal power to electricity.

Tiffin, O.—The Tiffin Street Railway Company will, in all probability, adopt electricity for its road, for which the franchise has now been secured. Mr. H. W. Yeager is president, Mr. J. F. Bunn secretary, and Mr. J. P. Myers treasurer.

Toronto, Can.—The Davenport Street Railway Company has been organized by R. Jaffray, G. G. Mackenzie, T. H. Bull and others, with a capital stock of $30,000, to build a line connecting with the Toronto City service. It will probably adopt electricity.

Cheap Elevator Service.—Messrs Thurber, Whyland & Co., the wholesale grocers of this city, report that the elevator service recently installed in their place by the Sprague Electric Railway & Motor Company is the best and cheapest in the world.

Peoria, Ill.—The Committee on Streets and Railroads has reported in favor of the Rapid Transit Street Electrical Railway Company. It reported unfavorably on the petition of the Fort Clark Horse Railroad Company, but recommended granting the right to use electricity as a motive power for the unexpired time of the franchise.

Richmond, Va.—The *Street Railway Journal* in its June issue says: "There is no longer any room for doubt as to the possibility of operating a street railway by electricity, or the utility and economy of such a system, and a study of the details of the Richmond Union Passenger Railway as given in these columns will sustain the facts."

Ansonia, Conn.—A very interesting report on the Van Depoele electric railway at Ansonia, of which we gave details recently, is made by the Boston *Herald*. The road is in regular operation, and is greatly in favor with the people. The track abounds in steep grades and sharp curves, but the cars overcome every difficulty as easily as if running on the straight level road. The road carries freight as well as passengers.

New York City.—The Board of Aldermen have been induced by public comment and clamor to reconsider their refusal to allow the Fourth Avenue Company to run storage cars. A very lively discussion took place last week, when, after quite an animated debate on the reconsideration, the Board postponed its decision. Alderman Von Minden made his maiden speech, in which he declared himself to be against all railroads. The city got along without them once, and ought to do so again.

Revere, Mass.—For the past 15 months plans have been maturing for the formation of the Revere Electric Street Railroad Company. This company has already secured its locations in Revere, and the work of construction is to begin in a few days. Its officers are Washington G. Benedict, president; Horace B. Parker, vice-president; William A. Boland, of Thomson-Houston Company, treasurer; Arthur D. McClellan, attorney; directors, W. G. Benedict, H. B. Parker, W. A. Boland, A. S. Foster, Charles H. Coffin, president First National Bank Newburyport; H. N. Shepard; Charles S. Fifield, of Revere, A. D. McClellan and C. H. Thayer.

Electric Motors.—We may confidently look to see the speedy introduction of the electric motor for crowded local transportation. The state of the art has now reached a point where all may witness the principle actually applied and working satisfactorily under the ordinary conditions of daily life. A number of rival systems, each, no doubt, possessing merits of its own, compete for recognition as the best; but this antagonism is a sign of health. Very likely there will always be such a competition, just as we find different makes of sewing machines or of steam engines. But the main fact is that the utility of electricity as a motive power for railway transportation has now been demonstrated, and is rapidly coming into use. Experience must decide among rival systems in the light of the record of each, and of the peculiar conditions of locality.—*Com. Advr.*

PERSONALS.

Mr. C. J. Kintner has been appointed chairman of the examiners of employés for the Board of Electrical control.

Prof. A. G. Bell, at a recent meeting of the Fortnightly Club, in Washington, read a paper on recent inventions for recording and reproducing speech.

Dr. Robert Amory has been appointed manager of the Boston Exchange of the N. E. Telephone and Telegraph Company in the place of Mr. Clarence A. Perkins, resigned.

Mr. George G. Ward is home from Europe, having made the fastest trip on record, which was just what might have been expected of him. He came by the "Etruria." He says there will be no change in cable rates at present.

Mr. H. Edmunds, of the firm of W. T. Glover & Co., of Manchester, England, is now in this country on a business trip. Mr. Edmunds is already well known here, having taken more than one American invention to England for introduction.

Mr. James Rascover, for eighteen years connected with Kiernan's Wall Street News Agency, is one of the best-informed and most popular of the down-town business men. He has just been admitted into the firm of Frank Kiernan & Co., as junior partner.

George E. Westinghouse, the inventor of the Westinghouse brake, has purchased 75 acres on a hilltop near the Smith Stock Farm, Lenox, Mass., for which he paid $75,000. He will build one of the finest residences there to be found at any resort. His architect and contractor were on this week to look the ground over and determine the best location for the residence. It is said

that his house and stables and other buildings will cost over $1,000,000. I am told by a gentleman who knows something of the financial affairs of Mr. Westinghouse that he has an income of $120,000 a year from his air brakes, his electric lights, and various other enterprises.—*N. Y. Times Corr.*

Mr. E. E. Higgins, who has been engaged with the Standard Electric Company, of St. Johnsbury, Vt., has now taken the agency for the Sprague motor for the Western part of New York State. His territory includes Buffalo and the Niagara Falls, and we have no doubt that Mr. Higgins will endeavor to utilize some of the waste power of the Niagara River.

SPARKS AND FLASHES.

Motto for a church : "Spare the rod and spoil the church."—*Lond. Elec. Engr.*

The resistance of the human body, according to J. L Sullivan, is very small, but has increased lately.—*Lond. Elec. Engr.*

"An Electric Dude" Wanted.—Mr. Edison having completed his experiments on the phonograph, will now turn his attention to an electric dude capable of keeping up an intelligent conversation for ten minutes. The invention will be entirely for social use.

MISCELLANEOUS NOTES.

Boston, Mass.—The Boston Electric Railway Signal Company has been incorporated by G. S. Barnes and others, with a capital stock of $5,000.

Kansas City, Mo.—The Electric Line Company, of Kansas City, has been incorporated by L. H. Holmes and others, with a capital stock of $10,000.

Wiring Tables.—The Edison United Manufacturing Company issued recently a neat little folder of wiring tables for the use of Edison agents and contractors.

Safety in Theatres is to be obtained, according to a New England inventor, by placing each seat over a trap door, so that on touching an electric button the occupant can drop himself into the cellar and escape that way.

New York Subways.—The Commissioner of Public Works has recently issued a number of permits to the Subway Construction Company to open a number of streets for the construction of electric conduits. Several of the principal streets will be opened, including Broadway and Sixth avenue.

The Court of Patent Appeals.—The committee of the National Light Association having in charge the bill to create a court of patent appeals, has received endorsement of the plan from the Patent Bar Association of Washington and letters of approval from the Justices of the Supreme Court.

New York Subway Workingmen's Organization.—The Subway Workingmen's Organization met last week and chose these officers: President, William F. O'Brien; vice-president, Joseph P. Daly; secretary, John Brady; treasurer, David Dunn; sergeant-at-arms, John Downey. The society is determined to see that the electric wires are put under ground more expeditiously than at present, and will hold meetings every Friday night.

Electrical Music.—A band, which includes wind instruments, has recently been operated at the Liverpool Exhibition by Carlo Bozza, an Italian, by means of electricity. The band is now to be taken to the Italian Exhibition in London. All the instruments, it is said, are played from a key-board, or switch-board, about 20 inches square. It is said that Bozza has also invented a new instrument, made of porcelain, which is playable only by electricity.

Edison's Old Workshop.—It is reported from New Jersey that the Pennsylvania Railroad Company is making an effort to clear out the tramps that have infested certain portions of its lines. At Menlo Park the large frame building which was formerly used by Mr. Edison for workshop purposes served as a lodging house for months for several of these tramps; but one morning one of the tramps refused to get up and go on a foraging expedition, so his comrades burnt him out, destroying the building.

The Copper Trust.—It is said that the copper trust is being subjected to a strain which may prove fatal to its success. The artificial advance in the price of copper has stimulated the producing capacity of a large number of new mines and at the same time has restricted the consumption of the metal. In this way the supply of available copper undisposed of is steadily augmenting and is already abnormally large, though the contracts of the syndicate have still two and a half years to run.

Underground Conduits.—We have received a printed copy of the opening argument made a short time since by Mr. Harvey N. Shephard before the Committee on Mercantile Affairs of the Massachusetts Legislature, on behalf of the New England Telephone and Telegraph Company, against the proposed exclusive subway franchise asked for in Boston by the American Conduit Construction Company. Mr. Shepard's argument is a very interesting statement of the case, and it embodies a number of letters from telephone officers in various cities, against any "general system" of conduits for electric wires.

Signal Service Thermometers.—A special dispatch from Washington says: The signal service is about to introduce in the principal cities self-registering thermometers. These thermometers will be connected by means of electricity with the dial that will be conspicuously posted on the outside of the weather buildings, and will record the temperature at the top of the building as indicated by the signal service thermometers. The dials will be useful and of great convenience to the public, who will thus have a ready means of knowing the official temperature without climbing to the tops of the high buildings where the offices are usually placed.

Welding by Electricity.—Electric welding has now been put on a commercial basis. The machines will be sold, but the company have a royalty on every weld made by their machines. To make this practical a meter is set upon them all. This meter has upon it three dials resembling those on a gas meter. By its peculiar construction, it is claimed, it will not register unless a perfect weld is made. The new company is backed by considerable capital, by which it is enabled to buy up all the experimental electrical welding methods in the country. These machines will weld anything in the shape of metal. They do not require that both metals shall be of the same material, as iron has been welded to brass in the experiments tried. The machines as they are now built will weld an iron cable or a watch spring with equal readiness.—*Boston Com. Bulletin.*

A Room Heated by Electricity.—Superintendent George A. Burt, of the Union Passenger (Electric) Railway Company, has had four of the "Burton" electric heaters placed in his office, of the same design as those tested on a car of the company this winter. These heaters are connected "in series," as it is called, and the heat radiated from their fourteen square feet of radiating surface is sufficient to warm a room of its dimensions—say fifteen feet square—during our coldest weather. The current for the heaters is supplied by a "shunt" wire from the supply cable in the street in front of the office, and is put on or cut off by means of an ordinary electrical switch inside the room. The resistance in the heaters is so regulated as to make the current used by them comparatively insignificant, being, as it is, one and three-fourths ampères, representing in energy three-fourths of one horse-power. It is the intention of this company to apply these electric heaters to all of its cars next winter.—*Richmond Dispatch.*

BUSINESS NOTICES.

Machine Tools.—E. Gould and Eberhard, Newark, N. J., are offering a large line of new and second hand tools at special prices, such as shapers, automatic gear cutters, presses, lathes, drills and engines.

Frames of every description for showcards and pictures can be had of William Levin, 37 Dey street. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

The Backus Water Motor Company, of Newark, have a number of their motors driving dynamos in different parts of the country, and claim to be able to give a first-class power service wherever there is a good water pressure.

George H. Thurston & Co., Providence, R. I., have purchased the stock and business of the Providence Electric Supply Company, C. H. Douglas, manager, and after this month will concentrate all their business at 59 South Main street.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Thomas Barraclough & Co., Limited, of Manchester, England, have issued a new price list of electric wire, strand and cable machinery made by themselves. The range of apparatus is very extensive, showing how large an industry that of covered electric conductors has become and how rapid has been the improvement in the appliances. The contents of the circular are of interest to all electrical engineers.

Hering's Principles of Dynamo-Electric Machines.—"'Hering's Principles of Dynamo-Electric Machines' is just the work I wanted. I think it is undoubtedly one of the most useful and practical books on electric lighting machines ever published, and should be in the hands of every electrician or any person very much interested in electric lighting. We feel very thankful to Mr. Hering and yourself for its publication."

W. O. COLEMAN,
Civil and Mechanical Engineer, West Point, Miss.

Magneto-Electric Water Alarm.—Mr. J. J. Ghegan has issued a circular of testimonials as to the merits of his magneto-electric high and low water alarm. Mr. T. A. Edison writes that it is "a most practical and desirable safeguard against the ever-present danger of insufficiency of water." Mr. Edward Weston writes that it is "a most reliable safety device." Other strong recommendations come from Krueger's brewery at Newark, the Murphy varnish factory, Hamil & Booth's silk mill at Paterson, etc.

Hering's Principles of Dynamo-Electric Machines.—"I feel assured that 'Hering's Principles of Dynamo-Electric Machines' will prove a decided help, particularly to students of electrical engineering who are designing and constructing dynamo machinery for experimental and testing purposes, and who need practical rules. I shall use it with 'Thompson's Dynamo-Electric Machinery' for our second year students in the electrical engineering course here." L. I. BLAKE, Prof. of Physics,
University of Kansas, Lawrence, Kans.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 29, 1888.

383,439. Electric Alarm Clock; Edward J. Colby, Chicago, Ill. Application filed Feb. 1, 1888. A pinion adapted to slide on its shaft is attached to a clock mechanism. The hub of the pinion is cut away at one place and a pin in the shaft drops into this cut away part and allows the wheel to slide, releasing a spring which makes an electrical contact and closes a circuit.

383,444. Galvanometer; Rookes Evelyn Bell Crompton and Gisbert Kapp, of Chelmsford, County of Essex, England. Application filed Sept. 27, 1884. Patented in England April 13, 1883, No. 1,877, and Sept. 18, 1883, No. 4,453; in France Sept. 26, 1883, No. 157,743; in Belgium Sept 26, 1883, No. 62,717, and in Austria-Hungary Dec. 24, 1883, No. 38,890 and No. 53,900. The invention consists in substituting for the permanent steel magnets electro-magnets which are excited by the whole or by a part of the same current which is to be measured.

383,450. Printing Telegraph; Samuel V. Essick, of Brooklyn, N. Y. Application filed May 18, 1887. The invention consists in the arrangement of a secondary angular bar or lever directly across the key levers of the transmitter serving to make and break the circuit to the receiver when any one of the secondary key levers is depressed.

383,464. Thermo-Electric Generator; Robert Jacob Gülcher, Berlin, Germany. Application filed Jan. 18, 1888. A thermo-electric element, consisting of a hollow cylindrical body provided with a small base surface at one end for receiving heat and a large cooling surface. See illustration.

383,484. Manufacture of Filaments for Electric Incandescent Lamps; James W. Packard, of New York, N. Y. Application filed April 6, 1888. An arrangement for short circuiting the filament while it is being connected with the leading in wires without liability of breaking.

383,485. Electric Punch Register; Augustus C. Palmer, Utica, New York. Application filed Nov. 20, 1887. The invention relates to electric registering machines, by which holes are punched in a strip of paper for fire-alarm, police or other purposes. It consists of the details of construction.

383,495. Test Circuit for Multiple Switch-Boards; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Dec. 27, 1886. The invention consists in connecting the different telephone lines through the switches upon the different boards and back to the subscribers' stations, respectively, and in connecting the different lines at their respective stations in such a manner that one branch will be open at the subscriber's station when the telephone is in its normal position upon the switch lever, while the branch containing the bell and generator will be closed to ground.

383,502. Apparatus for Lighting Railway Cars by Electricity; Illius A. Timmis and Stanley C. C. Currie, of London, County of Middlesex, England. Application filed July 29, 1887. An independently-driven dynamo mounted upon a locomotive, an electric charging circuit running from the generator through all the cars, a secondary battery in each car and in said circuit, lamps in the car in multiple arc circuit with the charging circuit and secondary battery, and a circuit controlling device which simultaneously cuts out and lets in both the generator and the storage battery.

383,520. Production, Transmission and Distribution of Electric Currents; Chas E. Fritts, of New York, N. Y. Application filed Oct. 7, 1885. The invention consists in producing, by any suitable or known means, a varying current, whether alternating, undulating or intercepted, therewith charging an electrical condenser to its own potential, and by the varying charge of condenser inducing currents upon and over the one or more sections of the line or circuit, each of which is inductively united to the adjacent section by a condenser in like manner and the last one to the other pole of the generator repeating this operation fast enough to keep the electrical impulses constantly flowing over the line.

383,536. Thermo-Electric Apparatus for Controlling the Temperature of Water in Pipes; Edwin A. Newman, Washington, D. C., Assignor to the Newman Anti-Freezing Water Pipe Company, of Chicago, Ill. Application filed Dec. 30, 1887. A thermostat is arranged to close a circuit whenever the weather approaches the freezing point. The circuit controls heating devices in connection with the pipes.

383,548. Electric Battery; Edward A. Wildt, Long Island City, New York. Application filed Sept. 2, 1887. A glass partition provided with perforations extends across the cell, separating the electrodes.

(1) 383,560. (2) 383,561. (3) 383,562. (1) and (3) Secondary Batteries; (2) Propelling Vehicles by Electricity; Camille A. Faure, of Paris, France, Assignor to the Electrical Accumulator Company, of New York. Applications filed respectively April 20, 1881; May 25, 1887, and April 20, 1881. Patented in foreign countries as follows: (1) France, Feb. 9, 1881, No. 141,057; (2) France, Oct. 20, 1880, and in England, Jan. 11, 1881, No. 129; (3) France, Feb. 9, 1881, No. 141,057. (1) The first claim is as follows: The method of preparing the elements of secondary batteries, which consists in applying to the plates or supports the active material in the form of a paste prior to immersion of the elements in the battery fluid, substantially as described. (2) Method of operating a vehicle propelled by an electric motor supplied with current from a secondary battery carried by the vehicle, consisting in brakeing the vehicle and returning current to the secondary battery to recharge it by decreasing the electromotive force of the battery until the counter electromotive force of the motor exceeds it when the vehicle is on a grade or slowing down. (3) A secondary battery, consisting of a suitable inclosing cell, an electrolytic fluid in which the elements are practically insoluble, such as sulphuric acid and water, and two or more elements, each of which contains a plate or conductor and a previously prepared paste of active material in contact therewith.

383,563. Telephone Call-Bell System; Frank E. Fisher, of Detroit, Mich. Application filed Sept. 15, 1885. Designed to permit the use of two or more telephones in circuit without ringing the bells of all the telephones to call any one of them.

(1) 383,564. (2) 383,565. (3) 383,566, and (4) 383,567. (1) Armature for Electric Motors; (2) Dynamo Armature; (3) Annunciator; (4) Armature for Dynamos; Frank E. Fisher, of Detroit, Mich. Applications filed respectively Dec. 13, 1886; Oct. 3, 1887; Oct. 25, 1887, and Oct. 25, 1887. (1) A magnetic metal plate is inserted between the bobbins and the face of the pole pieces. (2) The manner of inserting the plates. (3) Annunciator. (4) Same as (2).

383,575. Manufacture of Secondary Batteries; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of Pennsylvania. Application filed Jan. 27, 1888. Hardened pieces of the active material are placed in perforations in the plate and the edges of the latter bent over to hold the active material in, and at the same time expose a large part of its surface.

383,583. Electro-Magnetic Register; James F. McLaughlin, Philadelphia, Pa. Application filed March 19, 1887. The details of an apparatus which may be operated by the make and break of an electric circuit.

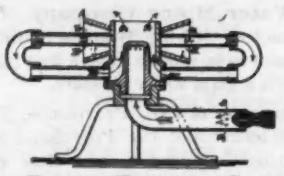
(1) 383,602; (2) 383,677. (1) Carbon Conductor for Electric Lamps; (2) Galvanic Battery Fluid; Hans Joachim Von Metzradt, New York, N. Y. Applications filed respectively Sept. 27, 1887, and Dec. 6, 1887. (1) Coke, anthracite coal and gas-house carbon in equal quantities combined with silicate. (2) Four hundred cubic centimeters of sulphuric acid, 200 of water, 200 of nitric acid reduced to 40 per cent., and 100 grains bichromate of potash.

383,605. Apparatus for Testing Electric Circuits; Alden D. Wheeler, Hyde Park, Mass. Application filed Feb. 2, 1888. The purpose of the invention is to arrange the various circuit wires in the several systems in such manner that the breaking of a wire in a certain system will not impair the efficiency of any thermostat in the system, and in connection with the systems employ a circuit-testing apparatus, such that if a break exists at any point it can readily be discovered and located.

383,611. Electric Cigar Lighter; Reginald Belfield, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Application filed Oct. 29, 1887. The invention consists in placing within a suitable holder a strip of wire of platinum or other suitable metal, arranged in any suitable manner so that its surface may be exposed to the end of the cigar, and in providing it with means for connecting it in an electric circuit when the cigar is in position to be lighted.

383,616. Incandescent Lamp; Henry M. Byllesby and Philip Lange, of Pittsburgh, Pa., Assignors to the Westinghouse Electric Company, of same place. Application filed Sept. 1, 1887. A metallic thimble is placed upon the neck of the globe and a glass plug inserted into it. One leading-in wire is at the centre of the plug and the other leads off to one side.

(1) 383,617. (2) 383,618. (3) 383,619. (4) 383,620. (5) 383,621. (6) 383,622. (7) 383,623. (1) Armature for Dynamos and Motors; (2) Synchronizing Device for Alternating Current Dynamos; (3) Armature for Dynamos and Motors; (4) Combined Alternate Current and Storage System of Electrical Distribution; (5) Alternate Current and Storage

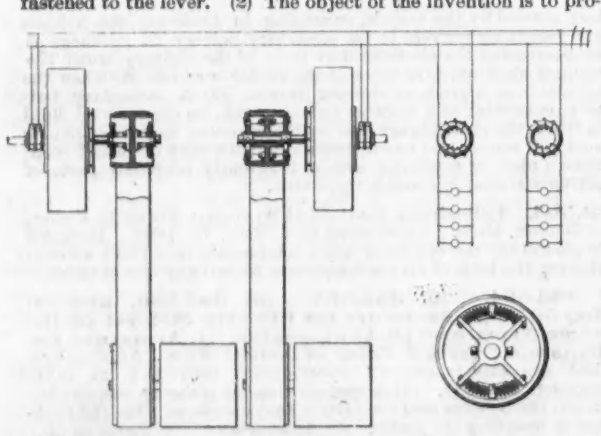


383,464. THERMO-ELECTRIC GENERATOR.

System of Electrical Distribution; (6) Alternate Current and Storage System of Electrical Distribution; (7) Combined Alternate Current and Storage System of Electrical Distribution; Henry M. Byllesby, of Pittsburgh, Pa., Assignor of all of the above patents to the Westinghouse Electric Company, of same place. Applications filed respectively: 1, 2 and 3 filed Sept. 1, 1887; 4, 5 and 6, Oct. 1, 1887; and 7, Feb. 25, 1888. (1) Clips similar to those of Shallenberger of this issue, but made of glass. (2) The invention consists, generally, in coupling the belt-wheels of alternate-current electric generators with the armature shafts through yielding connections which will allow a slight movement of the wheels with reference to the armatures, so that any force which may tend to accelerate one of two or more machines delivering currents to the same circuit will be expended in or absorbed by the yielding connections, and will not result in throwing the machine out of synchronism. See illustration. (3) The separating strips of Shallenberger are connected together by cross straps which pass over the wires. (4) The invention consists in employing, in connection with an alternate current electric generator employed for operating a system of electric distribution by secondary currents and a storage battery, apparatus for delivering rectified currents to the battery; and it also consists in employing the currents from the battery either as direct electric currents for operating electric motors or other desired apparatus, or, if desired, in the form of alternating, intermittent or pulsatory currents for operating the translating devices. (See illustration.) (5) A source of alternating electric currents, a current rectifier connected therewith, a storage battery supplied with currents through such rectifier, a system of electric distribution and conversion, a rheotome for transforming the currents from the storage battery into alternating currents and means for discharging the battery into said system through the said rheotome. (6) The invention consists in employing, in connection with a suitable source of electricity, a storage battery adapted to be connected with the source at such times as required, and a rheotome or circuit controlling device whereby the currents from the storage battery may be rendered alternating, as desired, for supplying the distributing system. (7) Modification of (6).

383,640. Storage Battery Plate; Charles D. P. Gibson, New York, N. Y. Application filed March 3, 1888. The plate consists of two sheets of metal, each formed with openings, the metal around the openings being forced outward on each side of the plate so as to form projections, and placed together with the projections on one plate touching the projections on the other plate.

(1) 383,647. (2) 383,648. (3) 383,649. (1) Switch for Adjustable Resistances; (2) Apparatus for Connecting Alternate Current Dynamos; (3) Voltmeter; Philip Lange, Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Applications filed respectively Sept. 1, 1887, Oct. 1, 1887, Oct. 29, 1887. A circuit controlling switch having a contact spring carried by the lever and pressing against the plates, consisting of a looped band of resilient metal having its ends project toward each other and fastened to the lever. (2) The object of the invention is to pro-



383,618. SYNCHRONIZING DEVICE FOR ALTERNATE CURRENT DYNAMOS.

vide convenient means whereby the relative phases of the currents delivered by several different alternating current generators may be readily determined. (3) A voltmeter consisting of two coils, their respective cores, a common support for the cores, an indicator moved by the support, and metallic and carbon resistances in circuit with the coils, and a box containing the same, consisting of two parts hinged together, one part carrying the carbon resistance, and the other the coils and metallic resistance.

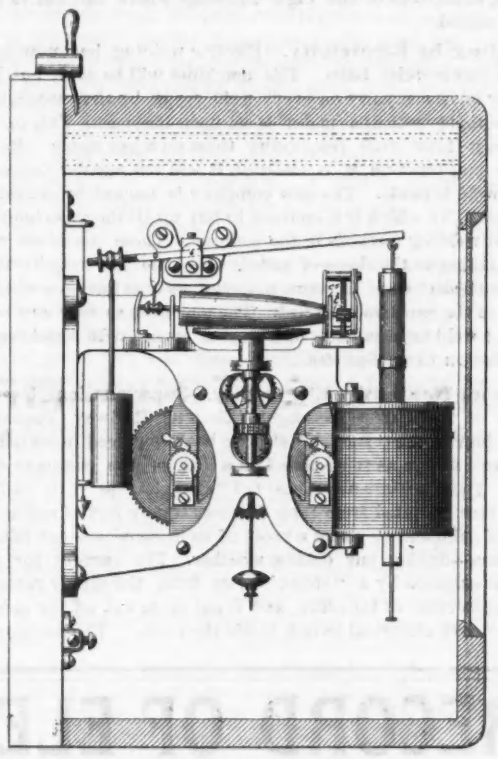
383,651. Governor for Electric Motors; Richard H. Mather, Windsor, Conn. Application filed Dec. 9, 1886. The device comprises a centrifugal governor, a rheostat connected in parallel with the helices of the field magnet and intermediate mechanism, through which the rheostat is manipulated by the governor.

383,655. Circuit Closing Device for Electric Clocks; Chester H. Pond, Brooklyn, N. Y. Application filed Dec. 21, 1887. Two revolving arbors, two contact arms projecting toward one of the arbors and actuated thereby to control the connections of an electric circuit and mechanism operated by the second arbor to throw the arms out of range of the first-named arbor.

(1) 383,657. (2) 383,658. (1) Bobbin for the Field Magnets of Dynamos; (2) Brush Holder for Electric Generators; Albert Schmid, Allegheny, Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Applications filed Sept. 1, 1887. (1) The bobbins have lugs at their inner ends for securing them in position. (2) A longitudinally adjustable rod carries the brush clamp, which is adjustable thereon.

383,659. Armature for Dynamos; Albert Schmid, Allegheny, and Henry M. Byllesby, Pittsburgh, Pa., Assignors to the Westinghouse Electric Company, of same place. Application filed Sept. 9, 1887. End clips are arranged in connection with a brass rim to hold the parts together.

(1) 383,661. (2) 383,662. (3) 383,663. (4) 383,664 (5) 383,665. (6) 383,666. (7) 383,667. (8) 383,668. (9) 383,669. (10) 383,670. (11) 383,671. (12) 383,672. (1) Circuit-Controlling Apparatus for Electric Lighting Circuits; (2) Coupling of Alternate Electric Current Generators; (3) Armature for Dynamos; (4) Armature for Electric Machines; (5) Indicator for Electric Circuits; (6) Apparatus for Detecting Ground Connections in Electric Circuits; (7) Method of Indicating Electric Currents; (8) Electrical Indicator for Alternating Electric Currents; (9) Electrical Indicator; (10) Electrical Indicator; (11) Electrical Indicator, and (12), Method of Indicating Electric Currents; Oliver B. Shallenberger, of Rochester, N. Y., Assignor to the Westinghouse Electric Co., of Pittsburgh, Pa. Applications filed respectively March 28, 1887; Sept. 1, 1887; Sept. 1, 1887; Sept. 1, 1887; Sept. 1, 1887; Sept. 1, 1887; Sept. 1, 1887, and Jan. 21, 1888. (1) This is a method for securing any desired circuit connection between different pairs of main lines or supply conductors at will. (2) Machines connected in multiple may be caused to perform each its proportionate amount of work. A self-inductive coil is provided, which is preferably adjustable for the machine which is liable to have less self-induction than the other. (3) An end clip having a metallic frame and a lining block of wood fastened into it. This receives the loop of the wires. (4) Sets of convolutions lying flat upon the face of the armature are separated by insulating strips. (5) Introduces into the circuit of the voltmeter an opposing E. M. F., the amount of which is proportional to the current delivered to the work circuit, and therefore approximately proportional to the fall of potential in transmission. (6) Lines leading from a source of alternating currents, conductors derived from the lines and including converters and leading to earth, and an indicating device connected in the secondary circuit of each of the converters. (7) A modification of (5). (8) An indicator acted upon by variations in alternating currents to indicate the same, two self-induction de-



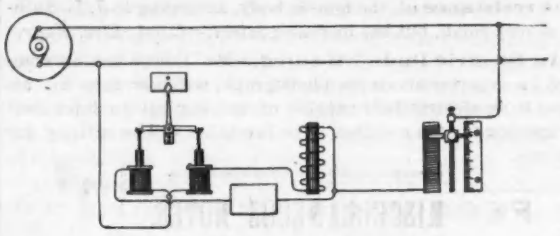
383,680. ELECTRIC METER.

vices and two resistances, respectively, in branch circuits spanning one of the induction devices and the indicator and the other of the induction devices and the indicator. (9) An indicator for alternating currents in combination with a conductor of high self-inductive qualities, whose coefficient of self-induction decreases with an increase of applied potential in circuit with the indicator, whereby the sensitiveness of the instrument is increased. (10) The invention consists in transmitting currents due to the difference of potential existing at the points upon two branch circuits of different self-inductions, and in placing in each branch circuit a solenoid or electro-magnet. These solenoids act in opposition upon a suitable indicating device, and thus the currents traversing the two are compared with each other. (See illustration). (11) An indicator for alternating, intermittent, or pulsatory electric circuits, consisting of two branch conductors, one branch containing a device of variable self-induction under variations in the difference of potential applied thereto, a device in the other branch opposing the flow of current therethrough, a conductor connecting points in said branch conductors, and an indicator affected by currents traversing said connecting conductor. (12) A method of measuring the difference of potential existing between two points in an electric circuit for alternating, intermittent or pulsatory electric currents, which consists in determining the amount of resistance required in a circuit of high self-induction through which said points are connected to establish a definite current therein.

(1) 383,675. (2) 383,676. (1) Manufacture of Incandescent Electric Lamps; (2) Evacuating Electric Lamps; Edward P. Thompson, Elizabeth, N. J. Applications filed respectively Jan. 22, 1887, and April 15, 1887. (1) The invention consists in attenuating the atmosphere within the globe and heating the leading-in wires independently of the filament to a higher temperature during the process of evacuating than they are heated after the lamp is sealed. (2) A device for heating the globes, consisting of a series of resistance conductors, an evacuated chamber connected with the globes containing the conductors and means for placing the conductors in an electric circuit

(1) 383,678; (2) 383,679. (1) Electric Meter; (2) Mounting Armatures of Dynamos; George Westinghouse, Jr., Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Applications filed respectively June 16, 1887, and Sept. 1, 1887. (1) The invention comprises a disc or circular plane, which is caused to revolve at a determinate and uniform speed, against the face of which bears a roller having in some instances the general form of a prolate spheroid. The periphery of this roller is in frictional contact with the face of the disc or revolving surface at a point which is more or less distant from its centre by the action of appropriate mechanism as the current traversing the apparatus is decreased or diminished. The roller receives a movement of rotation from the disc by friction, and is thus caused to turn upon its axis at a rate of rotation dependent upon the distance of its periphery contact from the centre of the revolving surface against which it bears. (2) In an electric machine, field-magnet poles arranged in a circular series and an armature mounted upon its bearings with its axis of revolution eccentric with reference to the circle of the field magnet poles, whereby the pressure of the armature upon its bearings is opposed by the excess of the magnetic attraction exerted by the nearer poles of the field magnet.

383,680. Electric Meter; George Westinghouse, Jr., and Philip Lange, of Pittsburgh, Pa., Assignors to the Westinghouse Electric Company, of same place. Application filed Oct. 29, 1887. In carrying out the invention a disc or circular plane or a curved surface is employed as the actuating surface. This is revolved at a determinate and uniform speed. Against its face there rests a roller having in this instance the general form of a prolate spheroid. The periphery of this roller is in frictional contact with the face of the disc or revolving surface. The point of contact is varied by the action of appropriate



383,670. ELECTRICAL INDICATOR.

mechanism, and is more or less distant from the centre of the disc as the current traversing the apparatus is increased or diminished. The consequent movement of the roller depends for its rate upon the distance of the point of contact from the centre of the revolving surface. See illustration.

383,706. Galvanic Battery; Harry B. Cox, of Cincinnati, Ohio, Assignor to George C. Cox, of same place. Application filed Dec. 17, 1887. A clock keeps a set of agitators at work, stirring up the solution in the cells.

383,725. Electric Needle Annunciator; Wm. E. Gill and Rudolph Segerdale, Chicago, Ill. Application filed Nov. 14, 1885. A slotted restoring bar, in combination with weighted levers, the weighted ends of the weighted levers being in the slots, and being restored thereby to their normal position.

383,734. Insulator for Electric Wires; Frank E. Keyes, Petersborough, N. H. Application filed Feb. 3, 1888. The insulator has a slot to receive the conductor and a metallic spring is arranged to normally cover the slot and keep the conductor in place.

383,757. Method of Filling Secondary Battery Plates; Henry G. Morris and Pedro G. Salom, of Philadelphia, Pa. Application filed Jan. 13, 1888. The invention consists in filling the cells or interstices of the grid with powdered active material, placing a uniform layer of active material on one or both sides of the grid, and then compressing the surplus material into the cells of the grid.

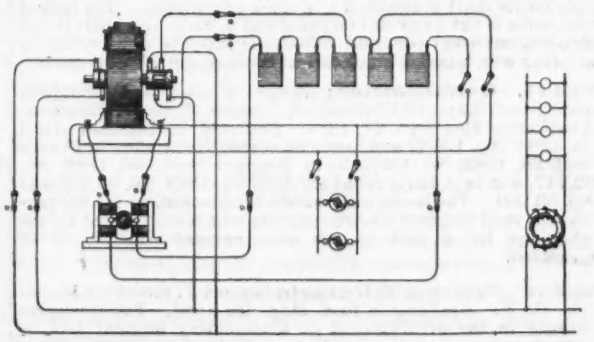
383,770. Underground Conduit and Grip for Electric Railways; Elias E. Ries and Albert H. Henderson, Baltimore, Md. Application filed Sept. 17, 1885. The conduit is made of non-conducting plastic material and the conductors are imbedded in it.

383,786. Electric Apparatus for Winding Clocks; Mariano Viau, Bilbao, Spain. Application filed Oct. 18, 1887. Patented in England Sept. 27, 1887, No. 13,091; in Belgium, Sept. 28, 1887, No. 79,028; in France, Sept. 30, 1887, No. 186,143; in Italy, Oct. 5, 1887, No. 22,429; in Spain, Nov. 20, 1887, No. 11,752, and in Austria-Hungary, Jan. 26, 1888, Nos. 44,130 and 50,189. A rheotome mechanism and a weight elevator, one wheel of the same communicating motion to the mechanism to be driven by the armature of the rheotome mechanism.

383,794. Electric Smelling Bottle; Charles T. Brown, Chicago, Ill., Assignor to Flora L. Brown, of same place. Application filed Dec. 23, 1887. The bottle contains a small battery which generates a current. This is directed through a sponge saturated with a smelling oil.

383,795. Device for Preventing Incrustation in Steam Boilers; William B. Bull, of Quincy, Ill. Application filed, Jan. 19, 1886. An electro-magnet is arranged to have both its poles in contact with the boiler.

383,832. Current Collector for Electric Machines Wm. Stanley, Jr., of Great Barrington, Mass. Application filed Sept. 1, 1887. Two continuous rings of metal are formed with



383,620. COMBINED ALTERNATE CURRENT AND STORAGE SYSTEM OF DISTRIBUTION.

outer bearing surfaces for receiving the contact brushes, and between them is placed an annular washer of non-conducting material within which passes a cylinder of similar material.

383,813. Relay; John E. Watson, of Louisville, Ky., Assignor to the International Electric Co., of same place. Application filed Feb. 1, 1888. An electro-magnetic relay provided with a continuously wound helix having a portion of high resistance connected in the main line, and a portion relatively of low resistance connected in a constantly closed local circuit passing its current in the opposite direction to that of the main voltaic current in the main line portion, to set up therein induced currents opposite in direction to the extra or otherwise induced currents of said main line to neutralize the same.

383,844. Overhead Conducting System for Electric Railways; Granville T. Woods, of Cincinnati, Ohio, Assignor to the Woods Electric Co., of same place. Application filed May 2, 1887. The conductors which give off the current receive it from a main or central conductor through the arms of the supporting brackets.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.